THE

ELECTRICAL REVIEW.

VOL. LXI. DECEMBER 20, 1907. No. 1,569.

ELECTRICAL REVIEW.

Vol. LXI.] CONTENTS: December 20, 1907. [No. 1,569.

	Page
Lord Kelvin	997
A London Electrical Trade Meeting	998
Manufacturers and Co-operation	998
Franco-British	998
The London Electrobus Co., Ltd. (*illus.*)	999
The Electrical Industry and Next Year's Exhibitions	1000
Correspondence:—	
The City Lighting; (Im)Pertinent Questions; Production of Energy from Peat; A Cheltenham Contractor Annoyed; Looping-in *v.* Joint Box; The Non-Technical Tramways Manager; Brakes for Tramcars; Premium Apprenticeship; Fault Localisation; Circular Questions	1001 to 1005
New Electrical Devices, Fittings, and Plant (*illus.*)	1005
Proceedings of Institutions:—	
The Electrical Operation of Textile Factories	1006
The Predetermination of Train-Resistance	1008
The Utilisation of Peat	1008
Legal	1008
Business Notes	1012
Electrically-Equipped Railway Shops in the Argentine (*illus.*)	1015
Notes	1022
City Notes	1024
Stocks and Shares	1026
Electric Tramway and Railway Traffic Returns	1026
Share List of Electrical Companies	1027
The Influence of the Rated Speed and Output on the Design of Continuous-Current Generators (*illus.*)	1029
Great International Exhibitions	1032
Electrical Pumping Installations (*illus*)	1033
The Chief in Embryo	1034
The Ideal	1035
New Patents Applied For, 1907	1035
Published Specifications	1036

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGHEKAY, LONDON." Code, A B C.

Telephone Nos. Holborn 993; Central 4425 (Editorial only).

ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.

ADVERTISEMENT RATES ON APPLICATION.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has

BY FAR THE LARGEST CIRCULATION

of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES.—Per annum, postage inclusive, in Great Britain, 19s. 6d., Canada, £1 1s. 8d. To all other countries, £1 10s.

BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.

CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each; post free 2s. 9d.

READING CASES, to hold from One to Twenty-six Numbers until the volume is complete for Binding, can be had from the Publishers, Price 6s., or Free by Post (in Great Britain), 6s. 6d.

FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. Paris: BOYVEAU & CHEVILLET, 22, Rue de la Banque. Berlin: ASHER & Co., Unter den Linden.

Cheques and Postal Orders (on Chief Office, London), to be made payable to Mr. H. ALABASTER, 4, Ludgate Hill, E.C.

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. BERLY'S).

1908 EDITION

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

4, Ludgate Hill, London, E.C.

LORD KELVIN.

ALL the world of science has been plunged into deep mourning this week. It has suffered a loss which is altogether irreparable, for Lord Kelvin, full of years and laden with many honours, passed peacefully to his rest on Tuesday, at 10.15 p.m., at his residence at Netherhall, Largs.

When Lord and Lady Kelvin went north a few months ago it was their intention to return to London at the close of the autumn, but the serious illness of Lady Kelvin required an alteration of all plans as to future movements. The news of her ladyship's recovery was most welcome, for those who possessed any knowledge at all concerning their private relationships knew how greatly Lord Kelvin had come to lean upon her. Quite lately one who was in daily touch with his lordship informed us that on all matters not purely technical he always sought Lady Kelvin's advice, and in the great majority of cases adopted it entirely. But alas! it was while detained at Largs beside his wife that the *doyen* of science himself caught a chill on November 23rd. A fortnight later the news was made public, and the daily bulletins, watched for with anxiety, have indicated that the end could not be far off.

When nations' sovereigns pass away, the very circumstances of our constitution involve the cry "*Le roi est mort—vive le roi!*"—the mourning of loss and the acclaim of successor almost intermingle. Not so can it be in the case of Lord Kelvin, sovereign scientist, benefactor of the entire human family, lovable man—for were the whole world summoned, no successor could there be, as in all that stands for greatness and for scientific brilliance he was alone.

Throughout his long life of 83 years Lord Kelvin was engaged in multifarious scientific occupations—in research, in invention, in practical achievement—and he leaves to all of us an example of unparalleled assiduity, nobility, piety and uprightness. Plunged into poverty by the loss of his presence—enriched beyond measure by the influence and example of so great a career.

We desire to express our very sincere sympathy with Lady Kelvin in her sore distress and bereavement, and pray that she may be sustained in this hour of her great sorrow.

A LONDON ELECTRICAL TRADE MEETING.

"It is not the honour we want—what we prefer is orders." These are not the words of a hustling, bustling trader or traveller caught by the fever of modern commercialism and tumbling over himself and his rivals in a restless and unscrupulous search for orders for tumbler switches or 5,000-kw. dynamos, nor are they the despairing words of one who having sought honours had found none. They formed one of many Hotel Cecil remarks of none other than our old friend Sir William Preece—*homo multarum literarum*—late Engineer-in-Chief of the Post Office, Past-President of the Institution of E.E., Civil Engineers, and so on, Chairman of the Olympian Electrical Display of 1905, uttered while machines were grinding out the last issue of the Electrical Review. Their object (one would like to think they were *gratis dictum*) was to impress upon a gathering of electrical trade representatives interested in the Manchester Electrical Exhibition of 1908, the essentially business and advertisement character of that undertaking. Sir William told of his 54 years' intimate and direct association with the electrical industries, and remembered a very successful Manchester exhibition with which he was connected in 1887—"there never was a more successful one in this country." But next year's event would be quite different in character, "much more like a gigantic bazaar," said Sir William. Now at bazaars they generally sell things, and the Manchester Chamber of Commerce has decided to do all it possibly can to further the object in view, subject to certain conditions, the chief being "that the exhibition shall not be made into a sale-room for articles to be taken away by purchasers." Between these two statements there need be no confusion as to the real nature of the exhibition. If it is to attract the *engineering* exhibitors and power-users, it must not be too much of a bazaar; if it is to beguile the general public, it must be popularly attractive. No doubt the organising authorities will easily be able to work up an acceptable exhibition to satisfy all parties.

The "perfect stream and flow of orders" following the 1905 display, is to be repeated at Manchester. In all of this Sir William was quite an electrical tradesman in his efforts to work up London enthusiasm, but he fell from grace—only temporarily, of course—when he immediately assumed another *rôle*. In his lengthy experience he has learned something of the value of advertising. Eyeing the electrical trade over the top of his glasses, he seriously said to a body of live business men: "There are many people still who believe in the success of printed and published advertisement!" As a reader he is delighted to get these advertisements, because, as a matter of fact, "they fill his waste-paper basket nearly every day." *Beatus ille qui procul negociis!* But the spasm of humour soon passed off, as there returned the recollection of the value of advertisement during 54 years in intimate touch with the electrical trade—advertising "is essential to business in its way, but there is no advertisement so successful as a well-conducted exhibition." Well, exhibitions are good things *occasionally*, but anyone attempting to make a comparison must remember that most firms spend as much upon a month's exhibition at Olympia or in Manchester as they do in advertising during a year or two; yet what do we find—do they adopt these means as a substitute for advertising in the Press? Something was said about the success of the motor shows at Olympia; now why are they so successful? One very important reason is that they lead the motor manufacturer to scatter additional advertising broadcast in the Press in a most liberal fashion throughout the whole run of the exhibitions; our newspapers teem with these advertisements—even have to refuse them!

Manufacturers and Co-operation.

But Manchester is to be made to serve another purpose besides the very important one of stimulating business. Sir William said that he had had a wide experience in touch with British manufacturers in all parts of the world, and he regretted that what he found was wanted amongst them more than anything else was "co-operation and mutual assistance." In some other departments of industry which were very successful they found co-operation and mutual assistance "rampant." On that blessed word "Co-operation" we say nothing now, for it may mean much or little, and the various criticisms that have been passed upon it in our "Correspondence" columns are still awaiting answer. But that word "rampant"—did Sir William really mean it? "Wild," "unbridled," "unrestrained," "exceeding all bounds"—such as "rampant ideas," "rampant weeds,"—these are some dictionary definitions. Some of our correspondents at least will quite agree that the word was ill-chosen, if intended in advocacy of co-operation.

The spirit of co-operation amongst electrical manufacturers is to be developed at Manchester, for the exhibition is hoped to be the means by which manufacturers, retail dealers, and others throughout the whole country, shall meet together, leading, perhaps, to the initiation of an institute of some sort or other, which shall not be confined to professional men, as most of the institutes are now, but which shall affect questions of trade and of manufacture. It was "perfectly marvellous," we were told, how co-operation had forced gas, our severest competitor in London, to the front. Gas men were "a body mutually helping each other, working for each other, co-operated in every way." This was one of Sir William's great reasons for urging electrical co-operation at this meeting—called for the election of two representatives to the Exhibition Committee; but he was careful not to refer to the recent split in the Automobile Unions.

Councillor Kaye, of Manchester, is a member of both the gas and electricity committees there, and he informed us that the recent gas exhibition had undoubtedly done the city gas department good; he welcomed this electrical exhibition purely because he thought it would make it good for his electricity department. This point he emphasised in unmistakable terms three times in his short speech—they looked upon the exhibition solely as a business enterprise. He could not just then say more than that with regard to their assistance in any shape or form. In view of the question of guarantors and the probable position of the Manchester Corporation in the matter, raised by Mr. H. Bevis, it was as well that this should be clearly understood.

Speeches over, the meeting balloted for London representatives to the committee, and Mr. J. E. Kingsbury (Western Electric Co) and Mr. Grainger (Sunbeam Lamp Co.) were appointed, with the understanding that Mr. Bishop (of the Edison & Swan Co.) would act should Mr. Kingsbury, who was not present, decline the honour. We are now informed that Mr. Kingsbury cannot accept office.

The last paragraph only, relates to the business for which the trade were really called together. There was no discordant note expressing any view against the holding of the exhibition, and we hope that the financial arrangements will develop satisfactorily, so that the scheme may soon take practical form for circulation among the trade generally.

Franco-British.

The meeting was now in for a surprise. The chairman called upon Dr. Glazebrook to say a few words about a matter that he desired to bring before the trade. Had he called the trade together by circular, and told them what he wished to talk about, we rather fancy he would not have required a hall at the Hotel Cecil. However, those who were there gave a courteous hearing, but the speeches of Dr. Glazebrook and Mr. Cunliffe Owen, of which a report appears on another page, failed to elicit the faintest applause or to arouse any evident enthusiasm for the Franco-British cause.

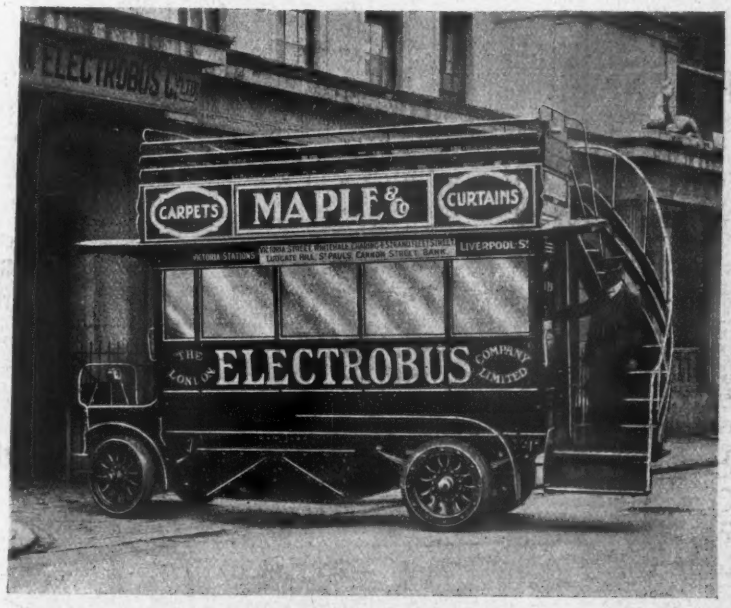
Perhaps there may be more response in reply to the invitation to the trade to place itself in communication with Mr. Northcote in order to ensure an adequate representation of electricity in some shape or form. Individual representation is quite out of the question for most firms, for reasons which need not be reiterated now. Yet a popular electrical representation, the cost of which might be met by subscriptions either in money or in kind, is perhaps worthy of consideration, in view of the aggressive attitude of gas interests.

THE LONDON ELECTROBUS CO., LTD.

We recently paid a visit to the garage of this company, in Horseferry Road, Westminster, and inspected the arrangements for handling the batteries, transforming the supply current, &c., under the courteous guidance of the engineer, Mr. T. Emmerson. Our readers will remember that some 20 months ago, when the prospectus of the company was issued, we found it necessary to criticise adversely the terms of that document, and that eventually the company returned their subscriptions to those who desired to withdraw. Since then the company has freed itself from the encumbrances to which we took exception, and has made a courageous effort to start afresh on sounder lines, with a degree of success upon which we are glad to congratulate the promoters. The new financial arrangements were set forth in our "City Notes" on November 15th; the present article relates mainly to the technical side of the undertaking.

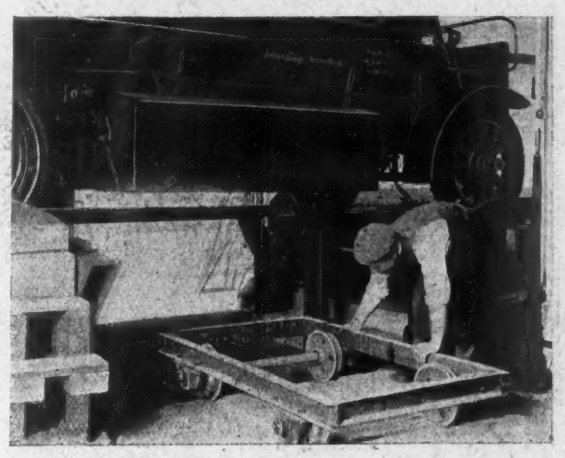
The company's omnibuses have now been running for five months, and have gained a marked degree of popularity, thanks to their smooth and silent running, which, with their freedom from evil odours and choking fumes, distinguishes them sharply from the ordinary motor-'bus. The appearance of the vehicle is shown in one of the accompanying views; some objection was raised to the peculiar colour of the earlier 'buses, but this has now been altered, with an immense improvement in the smartness of the exterior. Each 'bus provides accommodation for 34 passengers, and weighs when fully loaded 7 tons, of which the battery accounts for about 1½ tons.

Some of the 'buses are equipped with double-commutator motors, driving the differential through a longitudinal shaft, which passes between the two halves of the battery; in the later examples this arrangement has been replaced by two separate motors, driving a divided countershaft, from which the rear wheels are driven, Morse chains being used with a total speed reduction of about 9 to 1. The controllers are on the series-parallel tramway principle. The batteries are carried in iron-bound crates, slung beneath the vehicles; these are handled in the garage by means of a hydraulic lift, shown in two of our views, small trolleys being used to receive the crates and transport them to the charging bays. Twenty 'buses can be dealt with per hour.



The Electrobus.

Two types of accumulators are in use, made respectively by the Tudor Accumulator Co., Ltd., and the Gould Storage Battery Co., of New York. It is interesting to note that the Electrobus Co. owns no batteries at all; they are owned, charged and maintained entirely by the makers, whose agents occupy separate battery rooms in the garage. The makers bear the whole responsibility for the upkeep and renewal of the batteries, in consideration of a payment of 2d. per 'bus-mile, the contract lasting for three years.



Battery Lift and Trolley.

There are 42 cells in each crate; the Gould type have Planté positives and negatives, of 400 A.H. capacity, while the Tudor plates are all pasted and have a capacity of 500 A.H. The charging rate is 40 to 50 amperes, at about 110 volts in the case of the Gould cells, while the charging voltage of the Tudor cells varies from 110 to 125 volts. The former have been running over four months, and the latter nearly as long; but none of the batteries have yet required overhauling. A run of 40 miles, representing five round trips, can be accomplished with a single charge, but usually only 36 are covered with the Tudor cells, and 28 with the Gould type. The average rate of discharge is 110 amperes, the maximum 200 amperes; the amount of energy used per 'bus-mile is about 0·9 unit, at 90 volts. The number of batteries required to maintain a complete day service is about 2½ per 'bus.

Energy for charging the batteries is supplied by the Westminster Electric Supply Corporation at 1d. per unit, and is transformed down from 400 volts to the voltage required for charging by two E.C.C. motor-generators, one of which supplies 500 amperes from each of two generators, while the other, with a single generator, supplies 300 amperes. The energy is paid for by the company, in addition to the maintenance and hire charge of 2d. per mile.

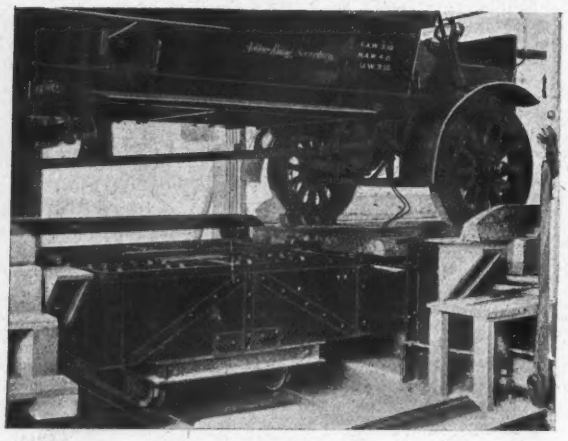
The total cost of running amounts to about 10d. per 'bus-mile, including allowance for depreciation, &c., and the receipts average over 1s. 1d. per mile, a value which testifies to the popularity of the electrically-driven vehicle.

At present the company has about eight omnibuses in service, running between Victoria and Liverpool Street stations. The drivers, having no repairs to effect, are not grimy and greasy, like those of the petrol 'buses, and their vehicles are under perfect control, both electrical and mechanical brakes being provided. The spectacle with which Londoners have become so familiar, of a motor-'bus (or 'buses) standing crippled and helpless at the roadside and blocking the traffic, has no application to the Electrobus, the simplicity and reliability of which are far above the standard of the petrol vehicle.

D

The garage at Westminster is capable of operating 50 'buses, which enter at one gate, change batteries, and leave by another gate. Workshops for ordinary repairs are provided on the premises.

A full record is kept of the performance of each battery, record cards being used after the manner recently described



Battery on Lift.

in connection with the Electromobile Co.'s vehicles. Between July 15th and October 31st 227,957 passengers were carried, at an average fare of 1·226d. per passenger, and a mileage of about 25,000 miles was covered.

We hope that the favourable results already secured will be maintained, and that the time may come when the noisy and noisome motor-'buses which at present turn our streets into a reeking Inferno will be wholly replaced by speedy, silent and comfortable electrical vehicles.

THE ELECTRICAL INDUSTRY AND NEXT YEAR'S EXHIBITIONS.

I.—Manchester.

In our leading pages we refer to what transpired at the Hotel Cecil on Thursday last week regarding the Manchester Electrical Exhibition. We are now furnished with the following list of firms represented at this gathering :—

Armorduct, Ltd.; Albion Clay Co.; Berry, Skinner & Co.; British Prometheus Co.; Easton Lift Co.; Electromotors; Edison and Swan; Electric Fittings Co.; Electrical Power Storage Co.; Falk Stadelmann & Co.; General Electric Co.; Hart Accumulator Co.; Heath, Samuel & Sons; International Electric Co.; Johnson and Phillips; Langdon-Davies Motor Co.; Lord, A. B., & Co.; Lundberg, A. P., & Sons; Marsh, Sons & Co.; Nalder Bros. and Thompson; Sunbeam Lamp Co.; Sterling Telephone Co.; Siemens Bros. Dynamo Works, Ltd.; Union Cable Co.; Union Electric Co.; and a number of electrical journals.

Messrs. Kaye and Pearce were present, representing the Manchester Corporation, Messrs. Barratt and McCowen representing the Salford Corporation, Messrs. Hustler and Roles representing the Bradford Corporation, Dr. R. T. Glazebrook representing the Institution of Electrical Engineers, and Mr. E. Cunliffe-Owen representing the Committee of London Supply Companies.

The constitution of the General Committee of the Exhibition now stands as follows :—

Representing Corporations Donating to the Funds.

Councillor Kaye, J.P., deputy chairman, Manchester Corporation Electricity Committee.

Councillor Barrett, chairman, Salford Corporation Electricity Committee.

Mr. Arthur A. Day, chief engineer, Bolton Corporation Electricity Department.

Mr. T. Roles, chief engineer, Corporation Electricity Works, Bradford.

A further nomination has yet to be made on this section of the Committee.

Representing Supply Companies Donating to the Funds.

Mr. C. D. Taite, chief engineer, Lancashire Power Co.

The following gentlemen were elected at last week's meeting representing general exhibitors :—

Nominated by the Electrical Manufacturers' Association.

Mr. H. Berry (Berry & Skinner), Mr. H. Nalder (Nalder Bros. and Thompson), Mr. H. Oppenheimer (International Electric Co.).

Nominated by the Meeting.

Mr. G. J. Grainger (Sunbeam Lamp Co.) and Mr. J. E. Kingsbury (Western Electric Co.), providing that he would serve. Mr. Kingshas since intimated that he cannot accept office, and Mr. Bishop, of the Edison & Swan Co. (next in order in the ballot), is accordingly elected.

II.—Franco-British.

As we state elsewhere, advantage was taken of this meeting of some members of the electrical trade for bringing further before their notice the matter of the exhibition at Shepherd's Bush. Dr. Glazebrook, who was chief advocate, and opened out the subject, said that he was aware that there was very considerable difficulty in asking them to take a share in two exhibitions somewhat near together in time, and he would hardly have ventured to do so, except for the fact that he did not think that there was anything antagonistic at all in the two; both aimed at exactly the same object—the furtherance of the electrical industry, and possibly a great deal might be done in London, as in Manchester, for that object.

The Shepherd's Bush Exhibition had very distinguished support, and very serious efforts were being made to make it truly representative both of English and French industries. There was a Committee managing the Engineering Section, which, he thought, was representative of British engineering, and the members of that Committee were most of them members of the councils of the various engineering societies. He was invited to represent the Institution of Electrical Engineers as being for the time being their president, and he was also requested to ask a number of gentlemen connected with London engineering to serve on the Committee of Management of the electrical portion of the Engineering Section. The speaker then named some of the members of the Committee, of which a list appears below.

The Shepherd's Bush Exhibition had not been organised for any private benefit. The funds were all guaranteed, and if there were any profits over they would be put towards establishing a fund to make exhibitions of that kind more easily possible in the future. The promises of support received from France had been very large indeed. One-half the available space had been taken by a very strong committee for organising exhibitors. It would not be to the interests of English electrical engineering trade if it were found that the French exhibitors were much more prominent than those from our own country. It was also true, he believed, that the gas industry were to be represented on a very large scale. There was to be a collective gas exhibit to illustrate as fully as possible what could be done by them in lighting, heating, cooking, and so on. One suggestion which he wished to put before them was that it might be possible to organise a somewhat similar collective exhibition of the electrical engineering industry. He thought there was good reason to suppose that if that were done the supply companies would be ready to come forward with substantial support. Mr. Cunliffe Owen, who was present, would be better able than he was to say what was possible in those ways. If the trade were willing to come forward and organise any kind of joint exhibition showing what the electrical industry could do, and was doing, then the support would be found to be forthcoming from the supply companies and others. He thought they would find that there would be ample opportunities for obtaining orders. The exhibition had been taken up very warmly by a large number of British Colonies, and representatives looking out for trade purposes would be over in great numbers. From them, he understood, considerable extensions of trade were possible. They wanted to make the electrical side of the exhibition worthy of British industry and enterprise.

Mr. Cunliffe Owen, speaking on behalf of the electrical supply industry, said that they felt that if the gas companies were going to have a big collective exhibit something ought to be done to counteract their show. Sir Wm. Preece had said that their great rival was gas, which had facilities for co-operation which, at the present time, the electrical trade did not seem to be quite so much up in. He hoped that advantage would be taken of the Franco-British Exhibition to show that the electrical trade could co-operate just as well as gas when their common interests were threatened. He thought it was important that they should not be behind-hand in showing the great advantages of electricity. With a bad cause the gas companies had done wonders by co-operation. If they did so well with a bad article, what could not electricity do? As supply companies, they could not show anything but "juice." Although he had no definite mandate from the supply companies that they would make any contribution, he could not help thinking that if they had some idea from the trade that they really meant to go seriously into the matter and give a good practical demonstration of electricity, the assistance of the supply companies would be forthcoming. He could not make any promises, because he had no definite assurance on that head. He asked for some definite expression of opinion from the trade. For a six months' exhibition the expenses were very great, but with a little organisation and

co-operation, a good many of those expenses might be materially reduced.

The Chairman asked those in the meeting to communicate with Mr. Northcote on the matter.

A vote of thanks to Sir William Preece for presiding was passed unanimously.

The following is a list of the Committee appointed by the Institution of Electrical Engineers :—

Chairman : Dr. R. T. Glazebrook, F.R.S.

Col. R. E. Crompton, C.B.	Mr. H. Hirst, M.I.E.E.
Mr. Philip Dawson, M.I.E.E.	Mr. W. M. Mordey, M.I.E.E.
Sir John Gavey, C.B.	Mr. W. H. Patchell, M.I.E.E.
Mr. F. Gill, M.I.E.E.	Sir Wm. Preece, K.C.B., F.R.S.
Mr. R. Kaye Gray, M.I.E.E.	Mr. A. Siemens, M.I.E.E.
Mr. R. Hammond, M.I.E.E.	Mr. C. Sparkes, M.I.E.E.

Mr. Killingworth Hedges, M.I.E.E.

Mr. S. W. Baynes, Associated Municipal Engineers of Greater London.

Mr. Cunliffe-Owen, Conference of the London Supply Companies.

Mr. W. R. Rawlings, Electrical Contractors' Association.

Mr. H. Talbot, Incorporated Municipal Electrical Association.

Organising Manager : C. S. Northcote, M.I.E.E.

Secretary : G. C. Lloyd.

Since the date of the meeting, Mr. Northcote has addressed the following communication to us :—

"Referring to the remarks made by Dr. R. T. Glazebrook and Mr. Cunliffe-Owen at the meeting of the electrical trade at the Hotel Cecil, I should be glad if you, in noting same in your next issue, would put on record clearly the fact, that as organising manager of the Committee responsible to the electrical section of the above Exhibition, I am desirous of obtaining support from electrical manufacturers interested in special or proprietory articles daily required by the public, in connection with the electrical installations. The possibilities of making a striking advertisement in conjunction with electric supply undertakings of London in a collective exhibition or demonstration of electricity, is one which will doubtless appeal to many, and although my Committee are fully aware that an undertaking of this description cannot be looked upon as an ordinary exhibition, yet it certainly affords a direct means of bringing the maker's or supplier's names of special apparatus, before the public. I am assured by several of the supply companies' officials that if I can make an application to them for support from a representative number of electrical manufacturing firms, the same will be forthcoming, and then arrangements can be made whereby the cost to each exhibitor or advertiser will be by no means excessive."

CORRESPONDENCE.

Letters received by us after* 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

The City Lighting.

In your issue of December 6th, Mr. Haydn Harrison publishes a set of curves purporting to represent the "direct" illumination for three City streets ; that is to say, the illumination on a surface held perpendicular to the rays of light. With the curves themselves we are not concerned, beyond pointing out that "direct illumination" is, in nine cases out of ten, a quite meaningless expression. What, for example, would Mr. Harrison wish to convey by the "direct illumination" in such a street as Whitehall ?

He goes on to remark, "I arranged that tests should be made simultaneously with a horizontal screen photometer of Everett, Edgcumbe & Co.'s latest pattern," and says further, that the "results obtained with this instrument . . . . diverged considerably from the actual results obtained by measuring the candle-power, distance and the angle of incidence."

What Mr. Harrison means by our "horizontal screen photometer," we are at a loss to understand, as we do not make such an instrument. Presumably, the instrument alluded to is the "Universal" photometer designed by Mr. A. P. Trotter, of the Board of Trade, and so called because, unlike others, it has a screen which can be set at *any* angle. We notice further that with commendable modesty Mr. Harrison refrains from mentioning that the inventor of the photometer which he compares so favourably with ours, is himself. We do not feel, however, that any such modesty need prevent us from going a little more fully into the technical points raised.

As far as we can see, Mr. Harrison's indictment amounts to either that the horizontal illumination as *measured direct* on the Trotter photometer did not agree with that *calculated* from readings obtained on his own 45° screen instrument, and that, since his own results must be right, ours must be wrong. This proposition seems hardly to admit of discussion, it is almost axiomatic in its simplicity.

The second alternative would appear to be that Mr. Harrison is surprised to find that the measured horizontal illumination does not agree with that calculated from the candle-power, and the cosine of the angle of incidence. We are glad Mr. Harrison has raised this question, because it emphasises what we have so long maintained, viz., that if the horizontal illumination is required, it must be measured and not calculated.

It is all very well to apply the cosine law to measurements made in a photometer room at short range and with well blackened walls ; but in a street the conditions are utterly different, and it is quite incorrect to assume that all the light reaching the photometer screen emanates from a given point or even reaches it from a given direction.

It is just for this reason that we are of opinion that Mr. Harrison's photometer is unsatisfactory. A correction, involving the cosine law, has to be applied to each reading. Mr. Harrison might as well expect that, if he laid a copy of the Electrical Review on the ground in the middle of, say, Piccadilly Circus, and held his umbrella in front of each lamp in turn, or even put an opaque screen in front of all the lamps simultaneously, that your valuable journal will cease to be illuminated.

There is no reason, when recording the result of street measurements, why each observer should not please himself as to whether the illumination be "direct" or "vertical," or at any other angle (although, since the horizontal is the only surface which can receive light from all the lamps at once, it is becoming the recognised standard). What we do maintain, however, is that, whatever the surface selected, the illumination reaching it must be *measured* and not *calculated*.

We may add, since Mr. Harrison has so strongly emphasised this point, that our experience, extending over some years, with the 45° screen recommended by him was not sufficiently satisfactory to lead us to take up that gentleman's present instrument when he very kindly offered it to us. We felt that some more universal arrangement was necessary, and decided to adopt Mr. Trotter's design in preference. In this instrument, as may be remembered, from the description which appeared in your issue of May 24th, 1907, p. 836, the screen can be set at any desired angle with the horizontal, so that both illumination and candle-power measurements can be made *direct* without the necessity for calculations or assumptions of any kind.

Mr. Harrison again raises the question of the supposed difficulty of making street measurements with any other form of photometer than the Flicker, owing to colour differences. This matter has been so often dealt with that we will now content ourselves with saying that, after using the Flicker photometer for street work for several years, we deliberately abandoned it in favour of the inclined screen pattern, and a remark of Mr. Harrison's, in his article, goes far, we think, to show that we were amply justified in taking this step. He says : "The results obtained in Farringdon Street are not plotted, as, owing to the low illumination, comparatively few measurements could be made."

Everett, Edgcumbe & Co., Ltd.
Kenelm Edgcumbe, *Director.*

London, S.W., *December 10th*, 1907.

As Mr. Edgcumbe has been good enough to send me a copy of his lengthy effusion dated December 10th, I conclude that he anticipates a reply, but as the matter from a technical standpoint has already been dealt with elsewhere, I only propose to call attention to one of the mis-statements contained in his letter, for the reason that it involves Messrs. Elliott Bros., who are manufacturing the Flicker photometer under my patent. It is quite true that I offered

the instrument to Mr. Edgcumbe's firm, for the simple reason that since 1902 they have manufactured and sold photometers to my design, including a horizontal screen type, but they were unable to accept my terms. I was, therefore, glad to be able to transfer the option to Messrs. Elliott Bros., whose reputation as instrument makers is second to none. This firm agreed to my terms, and have since manufactured and sold the instrument in considerable numbers.

In my opinion it is regrettable that Mr. Edgcumbe's habit of using "Correspondence" columns for advertising purposes has necessitated my writing this letter in order to put the true case before your readers, but perhaps this opinion is only the result of my modesty, which Mr. Edgcumbe so much commends.

Haydn Harrison.

London, S.W., *December 16th*, 1907.

We note from the above letter that Mr. Harrison evades all the technical questions that we raised in ours of December 10th, and merely accuses us of misstatements. Mr. Harrison's survey of events is perfectly correct as far as we can remember—the curious thing is that it is precisely what we said in our letter, only expressed a little more bluntly than we felt justified in doing.

In fact, Mr. Harrison's letter reminds one of the well-known legal formula :—"No case—abuse plaintiff's counsel."

Everett, Edgcumbe & Co., Ltd.
Kenelm Edgcumbe, *Director.*

London, S.W., *December 16th*, 1907.

[The practice of forwarding to one's opponent, copies of letters intended for publication is certainly courteous, but is also somewhat inconvenient, as may be gathered from the correspondence on this subject. We suggest that on a future occasion the parties to the controversy might with advantage go a little further and settle the matter "out of Court," communicating to us the result for publication.—Eds. E.R.]

(Im)Pertinent Questions.

You electrical engineers!

Have you noticed that other people do not work for glory but earn a living in their business or profession? Do you?

Have you noticed that if you buy, say, 'Xmas cards, you have to pay the price asked, and do not get a swarm round you offering to reduce their price to any figure to secure the order? Why not follow suit?

Have you any business other than giving sprats to catch mackerel? Do you ever catch the latter?

Have you noticed that, in many cases, no matter what price you quote your price is high? Funny, isn't it?

Have you noticed that, in many cases, no matter what price you quote you lose the order? Funny, isn't it?

Have you noticed how little money there is in your business, or whatever you call it, and what long credit people take? Dare you complain?

Have you noticed how very few really financially sound firms there are in your line?

Have you enjoyed yourselves this year, or has the question of profit and loss or the likely length of your present job worried you during the year?

Finally, is yours a business, profession, recreation, or a what?

Yours in simplicity,

Y,xz?

Production of Energy from Peat.

Referring to your comments on Mr. Tomlinson's paper in your issue of the 6th inst., will you allow me to submit a few points not dealt with in Mr. Tomlinson's paper, which, perhaps, may incline you to take a more favourable view of the prospects of the undertaking than your article conveys.

As one of the pioneers of the Lancashire, the Yorkshire and several electric power schemes, I have been led by experience to the conclusion that a busy industrial area is not always the best for the commencement of an undertaking of this nature, the ground being already occupied by manufacturers who are not prepared to scrap their existing plant until it is worn out, or nearly so. We have, therefore, to wait for the passing away of the old order of things before we can bring in the new, to any great extent. This accounts for the lean years that you refer to, that have had to be faced by some power companies in busy districts. The case is entirely different in a new and unoccupied area, not too far from the main centres of industry, where good traffic facilities exist and where cheap land can be obtained. There, every manufacturer who comes is an intending customer of the power company. We have seen proof of this at Niagara, where the power was so rapidly taken up by new works in the vicinity of the generating station, that it was the more distant places that had to wait until the new demands rising up on the spot were, to some extent, satisfied. Already we have had inquiries as to power for chemical works, for calcium-carbide works (good lime being obtainable in the near vicinity and carbon from the peat), for power for works for extracting alcohol from peat, and for inter-urban tramways. I am satisfied that we shall have the power taken up as fast as we can put down the plant, and that it is not the company that would have to wait for customers, but rather the other way.

As regards the more distant places, it is only about 25 English miles from our scheduled station site, along the Grand Canal to the centre of Dublin, or very little further than from Niagara to Buffalo. Dublin can, therefore, be reached by overhead mains carried on poles along the towing path the whole way. This cannot be characterised as a formidable and costly job. Moreover, it would not be necessary, as with underground insulated cables, to provide capacity in advance for an estimated future demand, which might or might not be reached, thus burying capital in the ground and increasing maintenance charges long before the former can be utilised. Bare wires of sufficient capacity for the time-being demand, with a reasonable margin, can be carried along the line of poles and added to from time to time, as required, to meet increasing demands, thereby keeping the capital expenditure always in just proportion to the demand. The heavy burdens imposed on the earlier companies, by insistance on the use of underground cables only, have been removed in the more recent Acts, so the experience of those companies to which you refer, in this respect does not apply to new companies under present regulations.

Neither has the example of the South Staffordshire Mond Gas Co. any bearing upon our case, as that company distributed gas in pipes under pressure, which we have no intention of doing, as we only propose to use the peat gas for generating *electricity* for distribution.

The previous attempts to utilise Irish peat proved commercially unsuccessful because they were all in the direction of making artificial fuel, involving costly manufacturing and drying processes. Drying the peat meant squeezing out and throwing away valuable properties in the water extracted from the peat, which had been soaking in it. We dispense with all those costly processes, and turn the raw peat, with about 50 per cent. of moisture in it, direct into the gas producer. The water, saturated with the properties drawn from the peat, is vaporised and passes off with the gas, and is afterwards condensed in the washing of the gas. The tar and its various products can then be extracted, so that it actually becomes more profitable to handle peat containing 50 per cent. of water than absolutely dry peat. This makes all the difference.

I need say no more, as Mr. Tomlinson's paper goes fully in all details of figures, &c.

J. Sturgeon, M.Inst.C.E.

Whitkirk, near Leeds,
December 13th, 1907.

Mr. Tomlinson, in his paper reported on page 953 of the Electrical Review, fears that the foreigner may exploit Irish peat, which he calls a great national asset.

It is quite correct that a peat-gas plant with by-product recovery is the most promising way of utilising peat; but as the air-dried peat as delivered to the producer has only about one-third the heat value of slack coal, the whole commercial problem is to get the peat delivered in this condition at not

over one-third of the price per ton of coal at the same place.

In Italy, where coal is very dear, labour very cheap, and where the climate permits of sun-drying the peat, without any capital charges, a peat-gas plant supplying electricity to local factories is feasible enough on a small scale. In the dry climate of America, something may also be practicable in this line; but in Ireland the problem is contingent on artificial drying involving heavy capital charges, which would alone render the use of this very bulky, low-value fuel, impracticable.

Mr. Tomlinson's theoretical calculations are that 60 per cent. of the heat value of the peat fuel as fed to the producer is available for the artificial drying of pressed peat; but this theory is quite mistaken. It assumes that a given number of heat units in the cooling water and exhaust gases from a producer gas-engine, have the same drying value as an equal number of heat units in the gases of direct combustion in a dryer furnace. He ignores the fact that the temperature of the cooling water is only about 120°, and therefore utterly useless for drying purposes; also that the waste gases are the product of an incomplete combustion, and therefore of trifling drying value. It is exceedingly doubtful if these exhaust gases would remove even 10 per cent. of the moisture involved in drying pressed peat with 70 per cent. moisture down to 45 per cent., as required for the producer. The only way to get this drying effect is to burn about *half* of the dried product in the dryer furnace.

Mr. Tomlinson shows that a ton of water-free peat can produce 480 B.H.P.-hours, provided sun-dried 40 per cent. peat is delivered to the gas producer; if, therefore, artificial drying and power for getting and pressing the peat must also be provided for, then 10 tons wet peat *in situ*, or a ton of water-free peat, would not give more than, say, 200 B.H.P.-hours, and this trifling result could never justify any appreciable capital expenditure, even if the sale of by-products would cover the working costs.

Charles Erith.

London, E.C., *December* 13*th*, 1907.

A Cheltenham Contractor Annoyed.

The writer would be glad of answers to the following questions:—

1. Is it possible for the Cheltenham Corporation to hire flame arc lamps, supply carbons, and carbon them for £1 10s. each lamp, and make it pay? This price includes all breakages, &c.

2. They having no powers to do this, where does the money come from to pay for the lamps?

3. What power has the borough electrician to stipulate conditions of wiring for these arc lamps?

4. It is surely getting unbearable that these men should use their position to aggravate the contractor at every turn. Cannot something be done to defend the man who does the grinding?

5. Are contractors going to allow this state of things to continue?

Anxious.

[Our correspondent's letter is somewhat obscure. We presume that the Corporation is letting lamps for the Christmas season on the terms named.—Eds. E.R.]

Looping-in v. Joint Box.

In your issue of the 6th inst. Mr. Girdlestone submits a system of wiring to save the unnecessary waste of wire by the present system of looping-in.

It is quite true that, in some cases, the looping-in system does run away with a lot of the profit, particularly on small installations.

Some three or four years ago I had charge of the lighting of the Young Women's Christian Association, Long Street, Cape Town, and the work (about 150 lights) was carried out on this system; the line wires were run in ⅝-in. Simplex tube on the walls in the passages, and outside each room we placed a box; the (mains) line wires were sweated into the Simplex Co.'s cable sockets resting on porcelain interiors (type E, Veritys' list), and the branches were run from each box into the rooms. All the fittings were connected with 3-plate ceiling roses or type G porcelain interors, screwed to the blocks behind the ceiling plates.

Another large installation, which I carried out on this principle, is Messrs. Stuttaford's, Adderley Street, Cape Town, of over 700 lights.

Instead of Simplex we used screwed insulated conduit with round cast-iron boxes of about 4 in. diameter and mounted ceiling roses on the lids at every lighting point (3-plate where necessary); this was all surface work.

In this instance we saved a lot of wire, and as the consulting engineer had specified that boxes were to be used at every light, the extra expense incurred in this respect was *nil*, and the only extra was a few 3-plate roses.

In the former installation I don't think the joint-box system was of any advantage, for what we saved in wire was expended on porcelain interiors, terminals, &c., but in the latter there was, without doubt, a great saving of both wire and labour.

In Mr. Girdlestone's diagram, I notice he uses 1 in. tubing for four 3/20 wires; why, I cannot understand. I have always been able to get four 3/20's into ⅝-in. tubing without any trouble.

In conclusion, I consider there is a lot to be said for both systems, and I don't think one deserves more praise than the other.

L. Brooke Allis.

Elland, *December* 14*th*, 1907.

We have read with considerable interest Mr. J. V. Girdlestone's letter on "Looping-in *v.* Joint-Box," in your issue of the 6th inst., and can fully endorse his remarks on the extravagance and waste of wire involved in employing the looping-in system. It is largely with a view to obviating this waste, in addition to effecting other economies, that we have placed on the market a joint-box for use with twin lead-covered wires. To any of your readers who are sufficiently interested in the subject to communicate with us, we shall be pleased to furnish full particulars.

The Accessories Manufacturing Co., Ltd.,
Ralph Ball, *Director.*

London, W., *December* 16*th*, 1907.

The Non-Technical Tramways Manager.

Your leading article on "Electricity Supply *v.* Tramways" in the current issue, is a very important and timely one, and in the writer's opinion it is opportune at the present moment to consider some of the claims made by non-technical tramway managers.

Statistics prove that the majority of municipally-owned tramway undertakings are satisfactory paying concerns, to the advantage of the ratepayers. Whether fares are comparatively high or low, the general public invariably appreciate the service and ride on the cars.

The commercial or technical ability of the respective manager will not affect the returns or revenue of any tramway, and the manager's function is to carefully watch the ratio of working expenses to revenue.

In the event of a large sum being handed over to the relief of the rates, the manager often claims credit for this laudable attainment, but it is well known that in all large cities, revenue per car-mile cannot fail—under any management—to show satisfactory returns.

As you truly point out in your leader, "there is undoubtedly a disposition on the part of tramway managers to claim for themselves larger powers," but does their training justify their ambition in this respect?

We have a recent instance where the cute Yorkshire councillors recognised that the manager of a tramways undertaking must be a trained engineer, and happily their opinion has been voiced and acted upon in other towns and cities.

It would be interesting to investigate the early training and general qualifications of, say, the members of the Brakes Sub-Committee of the Municipal Tramways Association who are now drawing up a report on this very important matter. Could any one of them give you, say, the co-efficient of friction of similar and dissimilar metals under

certain pressures? and are there any trained technical engineers amongst the members who are conversant with all the technical details appertaining to brakes?

The names of the respective gentlemen do not (and could not) appear on the members' list of any of our technical institutions, and in the writer's opinion it is regrettable that such is the case, for how can purely technical matters be properly reported upon by what have been aptly termed in one of your contemporaries "glorified traffic managers?"

Surely it is high time that ratepayers and Councillors were taught that engineers can always make commercial men, but purely commercial men can never be engineers.

The title "General Manager" has developed since the days of horse traction, and it will be observed that every manager of a tramway now styles himself general manager; the writer sympathised with a general a short time since, when he was informed that the power station, car-sheds and cables and overhead line in this particular city were under the charge of the electrical engineer of the Lighting Department. What a shame!

Mr. Dalrymple's policy is a sound one if the general managership is held by a duly qualified engineer, and it is to be hoped that the arrangement recently adopted at Halifax will be a guide to the Combined Committee at Leeds.

Survival of the Fittest.

December 16th, 1907.

Brakes for Tramcars.

With regard to Mr. Leslie A. Thain's idea for a slipper brake in your last issue, I am afaid that as shown in the sketch, there would be a decided tendency for the slipper to catch in the points and get carried away, and also if applied as shown, it is probable that at any point where the tongue was not perfect, one slipper would take one road and the other slipper the other road. I have experimented with a slipper of T section, both the ends turned up like a skate, and found that with the T a tight fit in the groove, the car would stop so suddenly that there is a probability of the brake gear being carried away, and with the T an easy fit in the groove the braking power was not sufficient to stop the car on a gradient with the ordinary pressure on the slipper gear, but it was a fine rail groove cleaner. Possibly with a means of applying sufficient pressure it would have been a success.

A. J. Howard.

December 14th, 1907.

Premium Apprenticeship.

In further reference to the subject of "Premium Apprenticeship," may I make a few remarks in favour of "a few" of those amongst them who, in my opinion, deserve at least a situation of £1 a week, which they cannot now obtain owing to the fact that such employment is already filled by more pupils.

The time is coming when pupils may not be found, as, for instance: A Corporation paid nearly £10 in searching the country for one such man; after some six months the genius came to light with £25 (divided equally between the Corporation and another—gentleman, showing a clear gain to the former of £2 10s.!—to the latter £12 10s.!

During the period of vacancy the plant was run without a switchman very often through the evening loads, whilst scores of former pupils in all parts of the country would gladly have stepped in for £1 or even 10s. a week.

Now, Sir, is it not possible that the Board of Trade limits of pressure were exceeded, at least once—possibly for long periods; shall we say simply defective supply over the whole area, and consequently one of the causes of the "disgraceful pass" indicated in "A Gentle Reminder."

Yes, much of the "disgrace" could be traced to the premium system, and sometimes to the premium man—not his fault, but that of some other "gentleman."

Parents wishing to launch their sons into municipal electrical management would do well to advertise for vacancy in pupilage in two cases, one offering, say, £50 a year premium, the other, no premium and no pay. Then the proportion of offers in the two classes will be proportional to the UN-attractiveness of the proposition. After all, it is the "cash" which lies at the root of the evil; pity the Committee which adds £5 or £50 to a revenue of £5,000 or £50,000; is it not equally miserable that such a body pay salary, less £5 or £50, to their able engineer of such strenuous professional learning?

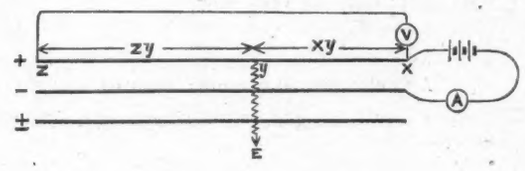
The real or unreal gain from premiums to the municipal body is insignificant, and it is deplorable that chairmen and engineers degrade the profession in so many instances, knowing the chances of the victims' success to be so very small. How many additional chief engineers, or chief assistants will be required during the next five years? What number of pupils will be released during the same period? I do not assume pupils to become chiefs in five years, although many expect it, and some rightly so; for there are, no doubt, a few who do advise the chief in technical matters from time to time, and often avert the disgrace of the undertaking by their superior knowledge in some branch, if not sometimes all branches.

Let us look forward to Board of Trade certificates in several branches of municipal work as a means of putting the right man into every position, irrespective of the multitude of other qualifications now recognised.

Square Root.

Fault Localisation.

I give below particulars of a test for fault localising, that is very simple and reliable on any system of mains. I obtained a perfectly accurate test under the worst possible conditions, viz.:—dead short, an earth on all three conductors of a triple-concentric lead-covered armoured cable laid alongside gas main, water main, electric tramway, and cast-iron cable ducts. Fault was due to a pick stroke 18 months old, and the inner core (+) was burnt clean through, but the next conductor (—) and outer neutral were only partly burnt through.



Send the current through the fault by one core and use another core preferably, or if not available, use earth as return. Run a voltmeter lead above ground to far as shown. Take simultaneous A and V readings and you can calculate $x\,y$ by Ohm's Law. It is worth while to take a series of readings on all cores and from both ends. The approximate resistance of cores being known from makers' tables, the resistance of $x\,y + y\,z$ should be equal to it. However, it is advisable to calculate the position of the fault from the core in which $x\,y + y\,z$ is equal to or slightly lower than the makers' figure, as that will be the core least burnt. This test is so simple that I don't claim anything original for it, but to be a success it must be possible to test from both ends, and a well insulated core or test-wire and accurate ammeter and low reading voltmeter are indispensable. I have used current from + of three-wire system with neutral earthed through resistance with great success, current going along cable through fault to earth.

A. J. Howard.

[We believe that a very similar test has appeared in our pages before.—Eds. E.R.]

Circular Questions.

I enclose a list of questions which have been sent by the electrical engineer of a certain Royal burgh in Scotland, and as these lists are constantly cropping up, I would be glad if you would allow me, through your pages, to strongly protest against them.

More than one half of the information required can be obtained from the technical Press, and in one item, that regarding load factor, a certain newspaper is actually quoted as to the method of obtaining load factor, although this is required to be filled in on the schedule. I think it ought to

be impressed upon station engineers that although their colleagues are anxious and glad to give all information that may be required on matters that are not given the publicity of the Press, they should at the same time give as little trouble as possible by not referring to matters which are made public from time to time in the ordinary technical journals.

A Borough Electrical Engineer.

[This matter has been the subject of many complaints, and has often been mentioned in our columns. Certainly, care should be taken to ask only for information which cannot be otherwise obtained. We have more than once suggested that the collated results of such inquiries should be communicated to the technical Press, so as to be available to all station engineers.—Eds. E.R.]

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

The Luxol Electric Signs.

The Edison & Swan United Electric Light Co., Ltd., of 36-37, Queen Street, London, E.C., are placing a new type of electric sign on the market. The sign is made with fully rounded glass letters, mounted so as to be interchangeable if required, and presents an attractive appearance not only whilst illuminated, but also by daylight. These letters resemble snow in colour, and are made with bevelled edges (fig. 1).

Fig. 1.—"Luxol" Sign.

The sign is more economical in use than any other type of electric advertisement, as a single 5-c p lamp is sufficient to illuminate the whole of an 8-in. letter. It is sold under the name of "Luxol," and the prices are stated to be very moderate.

The letters can be obtained in ranges of size suitable for all classes of premises, varying as they do from the small 4-in. letter, by successive steps of 6, 8, 10 and 12 inches, up to the large 16-in. letter, which naturally presents a most bold and striking appearance.

When fixed, the lamp and holder are completely covered by the letter, so that there is no light and shadow effect, whilst the entire depth of the letter and sign box need not exceed 5 in. The system is claimed to lend itself well to theatre and similar purposes, where the announcements require to be varied from time to time, owing to the ease with which the letters are interchangeable. By reason of the rounded surface of the letters, the sign can be seen and read with ease at an angle that would render the ordinary type of sign invisible.

If required, the sign can be arranged to work with a motor-driven switch for blinking, changing colours, or switching on letters in rotation. The lamps used with these signs are the well-known "Royal Ediswan." Full prices and particulars of "Luxol" signs can be obtained from any of the Edison & Swan Co.'s depôts, or from Messrs. Krupka & Jacoby.

New Circuit-Breaker for A.C. Motors.

In addition to the automatic release starters which we illustrated in our issue of December 6th, Mr. George Ellison, of 17 and 18, Warstone Lane, Birmingham, has just put on the market a new patent circuit-breaker, specially designed for the protection of alternating-current motors. The extensive and rapidly-increasing use of polyphase induction motors in industrial equipments has necessitated several radical improvements in the design of this class of apparatus.

The majority of electrical engineers, and not a few private consumers, are nowadays aware of the fact that alternating-current motors should be protected against overload and no-voltage on all or any of the phases, and there is no good reason why they should possess fewer protective devices than direct-current motors have.

Polyphase induction motors are usually equipped with an ordinary non-automatic starting rheostat, in order to reduce the starting current, which otherwise would reach a magnitude approaching short circuit. Should the attendant fail to bring this starting rheostat to the "off" position, when for some reason or other the supply is cut off, the motor will be subjected to these very heavy currents when the supply is re-established. It is obvious that this form of sudden overload may have disastrous effects, not only on the motor, but also on the machinery it drives, besides disturbing to a great extent the supply voltage.

Against these contingencies some reliable form of no-voltage and overload protection should be installed; that is, either starters with automatic no-voltage and overload release coils, or circuit-breakers provided with similar features, are required.

The circuit-breakers hitherto met with on the market have usually been equipped with two overload coils and three no-voltage release fine wire coils.

In Mr. Ellison's patent circuit-breaker, which is illustrated in fig. 2, only two coils are required—an overload coil which is inserted in the secondary or rotor circuit of the motor, and a no-voltage release coil, which is connected across one of the primary or stator phases.

Fig. 3 shows the connections of a three-pole circuit-breaker which is applied in connection with a star-connected three-phase induction motor. R is the rotor, S the stator, A the overload coil, and B the no-voltage release coil previously referred to. The coils A and B operate in the following manner:—If the motor is overloaded, it is obvious that the current in the rotor circuit will increase in practically the same proportion as the stator or line current, and the overload coil, therefore, will operate. In doing so it knocks off the retaining latch of the circuit-breaker, thus disconnecting the motor from the line.

In case of no-voltage or failure of the supply on all the phases the no-voltage release coil will operate, and again knock off the retaining latch of the circuit-breaker.

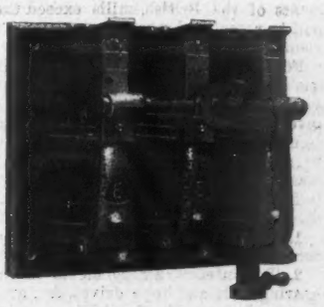


Fig. 2.—Ellison Circuit-Breaker.

Should the voltage fail on one of the phases only, through the blowing of one of the main fuses or through the breakage of a wire, the motor will keep on running as a single-phase motor, but the current in the rotor circuit will increase in a dangerous manner even if the motor carries only a comparatively small load. The overload coil A in such a case will immediately operate, and this causes the motor to be cut off from the line as before.

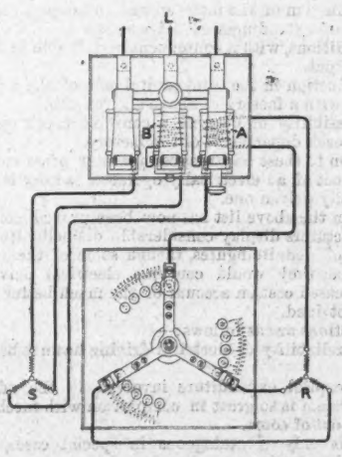


Fig. 3.—Connections of Circuit-Breaker.

Connecting the overload coil A in the rotor circuit, of course, means omitting the short-circuiting device of the slip-rings which is applied to a good many of the present induction motors. This

however, is an extremely simple matter, and it is claimed that the absolutely reliable protection obtained by the application of this new type of circuit-breaker compensates largely for the small percentage of motor efficiency thus sacrificed, and also for the wear of the slip-rings and brushes.

As an extra insulation precaution, an external resistance, which is inserted in the circuit of the no-voltage release coil, is used for voltages above 300 volts. For lower voltages, however, the no-voltage release coils are designed in such a manner that the external resistance can be dispensed with.

PROCEEDINGS OF INSTITUTIONS.

The Electrical Operation of Textile Factories.

By H. W. Wilson, Associate Member.

(*Abstract of Paper read before the* Institution of Electrical Engineers *at Manchester, November 26th*, 1907.)

Three years ago the actual horse-power of motors installed for driving textile factories in Great Britain was limited to a few hundreds, practically all in one mill, and only a very small fraction of the then total was actually in cotton mills.

So far as it has been possible to estimate from answers to inquiries sent by the various firms interested, the total horse-power which will be installed and running by about the end of March, 1908, will be about 28,000, and this is almost entirely in cotton spinning mills.

When, however, it is considered that in the United States and Canada there is something like 250,000 H.P. of motors installed in textile factories, and that the orders for such machines received by one firm during the past half-year, for supplying various mills in the States, amounted to about 25,000 H.P., or practically as much as has been done in this country in three years, and when besides it is remembered how very much the total power requirements of the British mills exceed those of the United States, it will be recognised what immense room there is for further development here.

For work of the class under consideration three-phase equipment has decided advantages over direct current. There is no special system in the driving of a textile factory which will inevitably give the best results, but there is scope for the exercise of an immense amount of judgment and knowledge of the conditions to be met in the arrangement for the driving of the various textile machines.

The advantages which the advocates of electrical driving urge for the operation of large textile factories are as follows:—

1. The mill and the engine house can be placed each in its most convenient situation without any regard to their relative positions.
2. The internal arrangements of the mill as regards shafting, gearing, belt and rope drives, &c., are greatly simplified and their costs reduced. The flexibility as regards extensions is, of course, obvious.
3. The grouping of the machines is much less arbitrary than in a mechanically driven mill, as the motors and the comparatively light shafting required by them can be placed where most convenient.
4. The reduction of the chance of a breakdown, which would stop the whole mill, to a minimum.
5. The ease of running one section for overtime or on special work.
6. The reduction of the maintenance and depreciation charges.
7. The greater steadiness of drive which can be obtained under suitable conditions, with a consequent permissible higher speed and increased output.
8. The reduction in the total capital cost of the mill per spindle or per loom with a factory of above a given size.
9. The possibility of keeping a constant check upon the results obtained in each department of the factory.

In addition to these advantages, a better price can be obtained for the product of an electrically operated factory than for that of a mechanically driven one.

Clause 7 in the above list has now been proved conclusively, but the manufacturers display considerable disinclination to allow the publication of definite figures, though some of them are prepared to admit that they would continue electrical driving even at a greatly increased cost on account of the much better results which are being obtained.

The objections are as follows:—

That the reliability of electrical driving has not been sufficiently proved.

That the capital expenditure involved in the adoption of the electrical system is so great in comparison with mechanical driving as to put it out of court.

That it is only advantageous in special cases, or where the average load-factor is poor.

That the efficiency of a mechanical drive is considerably higher than that of an electrical one.

The first objection may now be regarded as finally demolished.

The second objection, which is almost answered by the eighth clause of advantages, may now be fairly definitely withdrawn from the list. With a large spinning mill of, say, 100,000 spindles, after making allowance for all the structural alterations which can be effected, there is absolutely no increased capital expenditure, and if the factory increases in size beyond this limit the electrical equipment will work out more cheaply than the mechanical. The important items are the total abolition of the rope race, which under ordinary conditions is an expensive structure, and the reduced cost of gearing.

The fourth objection is still brought forward, and it is a very difficult thing to disprove. Where a mill has been converted from a mechanical drive to an electrical one, the I.H.P. of the prime movers has been reduced with the same machinery running, and this certainly tends to show that the efficiency of a mechanical drive is not usually as great as stated by its advocates. The probability is, however, that there is very little difference as regards the total power delivered, but the motors deliver the power at a more constant speed.

For the preparation machinery, including bale breakers, blowing machines, scutchers, cards, combers, roving and intermediate frames, group driving is the correct course to pursue.

For mule driving my own experience points strongly to the advantages of a group drive, but recently satisfactory results have been obtained from a motor driving a single mule with a suitable arrangement of fly-wheel effect in the system. Ring-spinning and ring-doubling frames individually give a practically constant load, and it is a very simple matter to couple directly a motor of 5 to 10 H.P., according to the size of the frame, to the machine and thus do away with all possible slip or transmission losses. It is, however, to be remembered that in a number of factories the ring frames are not always spinning the same class of counts, and, in consequence, a speed variation of the spindles becomes necessary. To effect this variation, in a large number of cases slip-ring machines with wound rotors have been installed, and the variation is obtained by inserting resistance in the rotor circuit.

There are three objections to this arrangement: The initial capital outlay upon the installation; the low efficiency of the motors when running with the resistance in circuit; and the heating of the resistances, which has sometimes been the cause of considerable annoyance. Textile manufacturers are generally apprehensive of the heating of resistances; and as the ordinary factory is always at a fairly high temperature, it would appear that in future installations of this character special cooling arrangements would have to be considered.

In cases where individual driving is adopted, but where speed variation on the spindles is not necessary, squirrel-cage motors with some form of friction clutch as a coupling have frequently been used, and have given satisfactory results. The capital outlay on these machines, including the clutches and auto-transformer starters, is distinctly less than upon the wound-rotor machines with regulating resistances, even though in this case the clutch coupling is not necessary.

The alternative arrangement for the driving of frames where variable speed is essential is to group the machines and drive with a single motor, changing the pulleys for speed variation, as is customarily done with the mechanical arrangement.

It is now, in nearly all cases, found possible to speed line shafts up to an extent that will permit of direct coupling to standard speed induction motors without any objectionable results arising.

The actual powers required need very careful investigation before the machines are installed, and it is by no means a safe rule to assume that the horse-power is so much per hundred spindles of the mill, as this may lead to considerable error. It is necessary to know the class of material which is to be produced, as figures from one mill only would be very misleading when applied to another mill with the same class of machines but manufacturing a different grade of material.

As regards the prime mover, from the point of view of perfect angular velocity the turbine offers obvious advantages, and for large sizes the capital cost per kilowatt is fairly reasonable. Recent practice seems to be in favour of installing two turbines, either of which is of sufficient size to run the mill by utilising to the full its overload capacity. My own preference for a mill of, say, less than 1,000 H.P., would certainly be in favour of a quick-revolution reciprocating set, but the slow-speed engine makers are now prepared to guarantee such favourable results in steam consumption that in spite of the extra capital cost their claims demand careful consideration. There is the added advantage that the average mill engineer is more familiar with the slow-speed engine than any other type.

Of the total horse-power in motors now installed in textile factories in this country, some 25 to 30 per cent. are driven from central generating plants, and this proportion shows every sign of increasing rapidly.

Upon the occasion of reading the previous paper I did not feel that the central supply authorities would be able to induce proprietors of spinning mills to take a supply at a price much above 0·35d. per unit in the case of large mills in the Lancashire district, where coal is cheap. However, some large factories are now paying considerably above this price, and are perfectly satisfied so to do; as regards mill-power costs, see Schedule II.

The advantages of taking a supply of energy hold good in an intensified degree to-day. If the mill owners make a contract for power at a fixed price, they become largely independent of the fluctuations in the price of fuel and also of strikes; they are freed almost entirely from all anxiety as regards stoppage from breakdown, and the capital expenditure saved on the generating plant can be very much more usefully employed in productive machinery.

Mill owners are coming more and more to recognise that a supply from a central authority is a good thing from their point of view. There is, therefore, little doubt that developments along this line are bound to be fairly considerable, and it would seem to be likely that eventually the generating stations of nearly all the cotton manufacturing towns of Lancashire will have a considerable demand from the textile factories within their areas.

SCHEDULE I.—Comparison of Capital Outlay for a Spinning Mill of 100,000 Mule Spindles,

Driven: (*a*) By Ordinary Mechanical Means. (*b*) By Three-phase Electrical Transmission.

(*a*) *Mechanical.*			(*b*) *Electrical.*		
Engines, piping, &c., erected	£6,000 0 0		850-kw. turbo-generator and auxiliary comp.	£6,600 0 0	
Boilers	2,000 0 0		Boilers	2,000 0 0	
Chimney and boiler seatings	1,000 0 0		Chimney and boiler seatings	1,000 0 0	
Reservoir	1,500 0 0		Reservoir	1,500 0 0	
Engine house	600 0 0		Engine house	400 0 0	
Engine bed	600 0 0		Engine bed	300 0 0	
Rope race	500 0 0		Motors, cables and switchboard	2,982 0 0	
Boiler house	500 0 0		Boiler house	500 0 0	
Economiser and house	750 0 0		Economiser and house	750 0 0	
Lighting generator and seating	1,200 0 0				
	£14,650 0 0			£16,032 0 0	
Gearing	3,000 0 0		Gearing, £550; pulleys, £250	800 0 0	
Total	£17,650 0 0		Total	£16,832 0 0	

SCHEDULE II.—Comparison of Running Costs for a Spinning Mill of 100,000 Mule Spindles.

Driven: (*a*) By Ordinary Mechanical Means. (*b*) By Three-phase Electrical Transmission.

(*a*) *Mechanical.*			(*b*) *Electrical.*		
Coal, 1,500 i.h.p.	£1,359 7 6		Coal, 1,400 i.h.p.	£1,268 15 0	
Wages—Engineer, 55s.; assistant, 30s.; two stokers, 28s.	352 10 0		Wages (no assistant)	277 10 0	
Oil, &c.	125 0 0		Oil, &c.	125 0 0	
Insurance—E, £100; B, £22; gear, £60; buildings, £20	202 0 0		Insurance—E, £100; B, £22; gear, £16; buildings, £10	148 0 0	
Rates, 7s. on 5 per cent. of £14,650	256 7 6		Rates, 7s. on 5 per cent. of £16,032	280 15 0	
Interest and depreciation, 12 per cent. on £17,650	2,118 0 0		Interest and depreciation, 12 per cent. on £16,832	2,019 15 0	
Total	£4,413 5 0		Total	£4,119 15 0	

Cost per kilowatt-hour for 850 kw., 56 hours per week and 50 weeks per year.
= 0·445d. = 0·415d.

Note.—Coal cost based on 2 lb. per i.h.p., 7s. 3d. per ton, 56 hours per week, 50 weeks per year.

In conclusion, I would draw the attention of the electrical manufacturers to the fact that for the expansion of the home trade in electrical machinery they are bound to look to developments in large industries such as the textile.

There is still a great deal to be learnt as regards the subject, but if due care is taken over the carrying out of future schemes, there is little doubt that it will not be many years before every new mill built in Lancashire will be electrically equipped, and it is also equally certain that these mills will be able to make a profit when a good many others cannot do so.

The Chairman (Mr. M. B. Field) said that for a steady home trade every attention would have to be given to the electrical equipment of factories of all classes.

Mr. C. D. Taite said that where electrical driving in weaving sheds had been tried, very excellent results had accrued. A manufacturer who had two sheds, one of which was driven electrically, and the other by steam, stated that the electrical drive stood far ahead of the steam drive; he got an increased output, his cloth was better, there was a greater demand for it on 'Change, and there was a reduced upkeep of his looms. If a man simply replaced his mill engine by a turbine without any stand-by at all, he was running very great risks. The solution of the problem seemed to rest upon the supply of power from an external source. With regard to the advantages of electrical driving, there was a very large reduction in capital expenditure, and he believed there was a very considerable increase in the output from the mill. An increase of 5 per cent. in the output from a mill really meant to the owner, if his calculations were correct, 1½ per cent. on the total capital employed. He had tried both the individual and the collective drive, and at the present time did not know which users appreciated the most. He installed wherever he possibly could the squirrel-cage machine; he found no difficulty in starting up with an auto-transformer, and it gave excellent results. He did not agree with the author as to the figures taken of the coal consumption. He thought that 2½ lb. of coal per i.h.p.-hour at about 8s. 6d. per ton would be nearer what the average mill owner had to pay.

Mr. Woodhouse said that in the Yorkshire woollen mills, although there were something like 240,000 h.p. of textile machinery running, they were rather slow to move. The Yorkshire Power Co. had something like 12 mills connected, and contracts pending for more. The Bradford Corporation had just made a big contract; the Huddersfield Corporation were doing the same, and had put down steam turbines to go into the power supply business. He thought that the advantage of power supply from a public authority was pretty well established. The induction motor was the right thing for practically all textile machinery. There was, however, a field open for a motor which would vary the speed of spinning frames, as the cop was wound. The diameter on which the thread was wound varied according as the layers were conical. The speed could be increased on the wind as it neared the centre, and decreased as it got outwards, and in such a case it seemed highly probable that a single-phase motor, with an arrangement for varying the speed as the bar which guided the thread on the cop rose and fell, would be successful. He was hoping to try it in Yorkshire on spinning worsted, and expected a considerable increase in output from the spinning frames. He quoted cases showing the increased output with the electrical drive, and in one case showed that the extra profit obtained paid the cost of the power. Electrical drive reduced the number of broken ends. Converting to electrical driving did not reduce the horse-power, but increased the output, and so for the same horse-power more work was turned out. The first element of successful conversion was that the mill-wrighting should be done on sound up-to-date lines.

Dr. Bowman thought that if electricity could be supplied at one-third of a penny per unit, it would not pay the mill owner to put down his own plant, but until it was sold at that price he was sure direct driving would beat it. It was, he thought, possible to save from £3,000 to £4,000 on what was given in the schedule for a mechanical drive. On the electrical side, if a turbo-generator were put down, it would have to be a double set, so that one set could take the whole or greater part of the power, and, therefore, one would be standing, a great increase in the capital charge.

Mr. Hill said that if a mill of 1,300 h.p. with 100,000 spindles were taken, the average load would be 800 or 900 kw. and the output would be about 2½ million units per year. The works cost would not exceed ·175d. per unit, and the total cost ·3d. or ·325d. per unit; he did not think it would pay a mill to take power from an outside source unless they could get it at something like ½d. per unit. The difference between ·325d. and ·45d. per unit with an output of 2½ million units per annum would be roughly £1,400.

Mr. A. B. Mallinson, referring to Table I, asked why the mechanical drive was handicapped by having a lighting generator at £1,200. If that included wiring, why was it not on the electrical side? The same amount was given to the reservoir for both electrical and mechanical drives. Referring to Table II, it seemed rather strange that the coal for the electrical drive was for 1,400 i.h.p., compared with 1,500 i.h.p. for the mechanical drive; and no cotton mill engineer would run an electrically-driven mill with all motors, &c., without an assistant, probably two. He also asked why the buildings only required half the insurance with the electrical drive as compared with the mechanical drive.

Mr. Blackmore said that a textile motor had to be specially built for textile work, and a rolling-mill motor had not the hard duty to perform that a textile motor had, for the reason that for textile work the insulation had to be entirely different from anything else; the motor had to be placed inside the spinning room, where the temperature was generally 85°, and the motor had to work at a constant temperature of 185°, and special insulation had to be supplied for this. He considered the item in the author's tables for motors and switchboards on the electrical side too low. Group driving was the only thing for mills. He recommended squirrel-cage motors up to at least 150 h.p., and said that it was possible for a modern mill to average about 1·98 lb. of coal per i.h.p.-hour with coal at 7s. 10d. per ton.

Mr. S. L. Pearce did not think they could expect to take on mills which involved the replacement of fairly modern steam plant, which had only been installed a matter of four or five years. There were again cases where steam engines were giving good results which had been at work a good number of years, in which the capital cost stood at a very low figure. In the United States the large increase was probably due to the fact that they were new mills. Where the power was metered on the low-tension side of the transformer, the losses were confined to the cables and motors. He thought that cases where it would pay a mill owner to put in a private electrical plant were very few and far between.

Mr. J. Colquhoun gave results of a test of a triple-expansion Corliss engine in an up-to-date direct-driven mill. Including the

heating of the mill, which was a considerable item, coming to about 5 tons of coal per week, the total coal consumption per I.H.P.-hour came out at 1·6 lb. The coal used was Yorkshire slack, costing 8s. 6d. per ton.

The Predetermination of Train-Resistance.

By C. A. Carus-Wilson, M.A., A.M.Inst.C.E.

(Abstract of paper read before the Institution of Civil Engineers *on Tuesday, December 10th, 1907.)*

The first section of the paper deals with the form of the resistance-equation. The different elements of train-resistance are considered—namely, journal friction, rolling friction, track resistance, flange action and air resistance, and the conclusion is arrived at that they may be divided into three groups distinguished by their relation to the speed. The resistances in Group 1 are independent of the speed, and include journal friction, rolling friction and track resistance. Group 2 includes resistance caused by flange action, which varies as the first power of the speed. Group 3 includes all forms of air resistance, which vary as the square of the speed. The resistance equation is thus shown to be of the form $R = A + Bv + Cv^2$.

The second section is devoted to the determination of the constants in the resistance equation. The different methods of making train-resistance tests, and the errors to which they are liable are considered, and formulas are deduced by which the constants for any given type of rolling stock may be obtained.

In the third section the resistance formulas are applied to a number of different cases, in order to ascertain how far they afford a correct predetermination of the resistance of trains. For this purpose a number of the most reliable tests available are selected, the resistance is computed by the aid of the formulas, and the resistance curve is then obtained and compared with the results of each test.

In the fourth section a number of practical questions are discussed in the light of the conclusions arrived at. The real value of roller-bearings in railway traction is shown to lie in the reduction of running-resistance and consequent saving of energy, and not in the reduction of starting effort.

The resistance of a coach is shown to depend largely upon the wheel-base of the truck, and the relation of the weight of the bogie-trucks to that of the whole coach. The weight of the motors and the extra weight of the motor trucks in electrically-driven coaches increases the flange action and the total resistance of such coaches; the resistance of electrical motor-coaches is in some cases as much as 54 per cent. greater than that of trailing coaches running at the same speed under similar conditions. The influence of the bogie in reducing train-resistance is shown to be greatest in the case of goods wagons.

Since flange action depends upon the ratio of the weight of the bogie to that of the whole wagon, the resistance per ton of a loaded bogie wagon must be less than that of the same wagon empty. The results of tests are given in which a train of bogie wagons was hauled over a considerable distance backwards and forwards, first loaded and then empty. The ratio of the mean drawbar pull in the two cases was 0·56.

The amount of play between the flanges and the rails is an important factor in train-resistance. The increased resistance and wear occasioned by large flange play suggests the importance of a reduction of the play to a standard $\frac{3}{4}$ in., as on the London and South-Western and other railways.

The resistance of the air with a train of bogie coaches, running at 60 miles per hour, amounts to about one-half of the total tractive effort required to haul the train. The experiments conducted by the St. Louis Electric Railway Test Commission show that a large reduction can be made in the front and rear air resistance by shaping the ends, and that by this means a saving can be effected of 10 per cent. of the total tractive effort with a long passenger train, and 30 per cent. with a single coach.

The Utilisation of Peat.

At a meeting of the Dublin Section of the Institution of Electrical Engineers on the 12th inst., a lecture by Mr. A. B. Lennox, of Newcastle-on-Tyne, on "The Getting and Drying of Peat with a view to its use for the Generation of Electric Power," was delivered by Mr. Cunningham, in the unavoidable absence of the author.

Mr. Lennox mentioned that the getting and drying of peat was a very ancient industry. He proposed to show that by his method of doing the work it was reduced to a piece of very ordinary engineering, the total cost of getting and drying of the peat to contain not more than 45 per cent. of moisture, not exceeding 2s. 6d. per ton in cases where the works were situated alongside the moss.

Nearly all the big deposits of peat in England, Scotland and Ireland were in low-lying districts, the greater depth of the peat submerged in water, and the better part of the peat—the lower layers—was, consequently, by ordinary methods, difficult to get. With his method, however, the water became a valuable aid, instead of a hindrance, as he used a floating grab dredger for digging, which cost only a fraction of the cost of hand digging to operate.

The dredgers could be floated on either barges or pontoons, the latter being preferable, as a platform can also be constructed to carry the slicing and moulding machines. The machine has a jib radius of 16 ft., so that in cutting its way through the peat moss, it forms a canal about 30 ft. wide. The total cost of this machine, including pontoon, wood deck, fittings, anchors, chains, &c., is about £750, delivered and erected.

Mr. Lennox showed by detailed figures of the various operations that the cost of digging 1 ton of peat would not exceed 3d.

The peat, after being sliced and moulded to a suitable size, is delivered on to a conveyor belt and run on to drying palettes consisting of wood trays in tiers of six carried on wood gantries, a suitable lifting bogie being provided for moving the palettes. The gantries and tramways are all formed of wood and arranged so that they can be moved about very quickly. The sleepers are 9 in. to 12 in. wide, so that they present a broad surface to the moss. Two men can lay 100 yd. per hour. The author fitted up 900 yd. of these gantries, and found that 9 to 10 tons per hour of peat blocks could be delivered on to the gantries at a cost not exceeding 2d. per ton. Handling the palettes at the slicing machine cost 3d. per ton. On top of the top palettes a waterproof cover can be laid. By this system the peat dries very quickly, as compared with the present system of drying by spreading it on the wet moss, and six times the amount of peat per acre can be so dried.

The peat is left on these palettes about a fortnight, when some 20 to 25 per cent. of moisture has been drained and evaporated. The hardened blocks are then conveyed either by an aerial railway or tramway to the works, where they are tipped into the hopper of an elevator to be conveyed into the auto-drier.

The auto-drier consists of a vertical steel chamber, and has a revolving inner vertical cylinder to which a series of shelves are fixed, dividing the steel chamber into compartments. The compartments are connected in pairs outside the casing by means of boxes containing shoots, so that the material is delivered from the top shelf to the next shelf below, and so on to the bottom one where the peat is delivered into a hopper or other means for conveying it to the gas producers. The heat necessary may be obtained from the gas producers and gas engines. The power necessary for driving the drier in a machine capable of reducing the moisture to 40 per cent. in 5 tons of peat per hour, does not exceed 20 B.H.P.

In conclusion, the author gave the following figures as the cost of getting and drying 100 tons of peat, which comes out of the drier, as about 50 tons of dry peat:—

	£	s.	d.
Dredging 100 tons peat at 3d.	£1	5	0
Slicing and moulding at 2d.	0	16	8
Filling on to palettes, six men at 4s. per day...	1	4	0
Conveying to drying gantries, wages to men...	0	8	0
Conveying 75 tons from gantries to works at 6d.	1	17	6
Cost of drying in auto-drier with waste heat...	0	8	0
	£5	19	2

or 2·4s. per ton of dry peat ready for gas production. The capital cost of a plant to turn out 50 tons per day, but exclusive of buildings, was £5,000. Such a plant working 300 days per year could turn out 15,000 tons annually. The author is at the present time installing such a plant in Scotland.

Mr. A. E. Porte, in moving a vote of thanks, said that the subject matter of the lecture was of the greatest possible interest to themselves. Griffith in 1814 estimated that there were 3,000,000 acres of peat available, the calorific value of which was about one-half that of coal, and was capable of generating 100,000 H.P. during 3,000 hours per year for 1,250 years, and as the life of a peat bog was, curiously, 1,200 years, the cycle of operation could be carried on continuously. I notice it had been estimated that the by-products of 100 tons of peat costing £15 were worth £100.

Mr. E. A. Aston said that previous failures to utilise peat were due to the adoption of wrong methods, and as considerable sums had been lost, he was afraid it would be a difficult matter to pursuade capitalists to embark on a new scheme. He suggested that the matter should be made a national one, and a Government grant obtained to develop the peat resources of Ireland.

LEGAL.

The "Electromobile" Appeal.

The case of the Electromobile Co., Ltd., *v.* The British Electromobile Co., Ltd., and others, which concluded before the Court of Appeal, consisting of Lord Halsbury, Lord Justice Vaughan-Williams and Mr. Justice Bigham on Monday, raised the question whether the word "electromobile" meant any motor-car propelled by electricity, or whether it meant an electric car of the plaintiff company.

The plaintiff company claimed an injunction to restrain the defendant company from using or carrying on business under the same style or title of the British Electromobile Co., Ltd., or any other style or name which included the plaintiffs' name or so nearly resembled it as to be calculated to deceive and confuse the public or to induce the belief that the business of the defendant company was the same as, or in any way connected with, the business of the plaintiffs. The plaintiffs also claimed an injunction to restrain the directors and the signatories of the memorandum and articles of association of the defendant company, from allowing the defendant company to remain registered under its present name or title, or any such title or description as aforesaid. The plaintiff company was registered in 1902, its business being the manufacture, selling, and letting on hire, of electric carriages and cars, and in November, 1902, the business of the then existing British Electromobile Co., Ltd., a predecessor of the plaintiff company,

was assigned to the plaintiff company, and the then existing British Electromobile Co. was wound up. On April 8th, 1907, the defendant company was registered under its present name.

The plaintiffs alleged that the electric carriages manufactured by them had acquired a great reputation, and were known in the trade as electromobiles, and that the word "electromobile" was understood by the public to mean an electric carriage made by the plaintiffs. They contended that the defendants' name was so similar to theirs as to be likely to confuse the public, and cause damage to the plaintiffs.

The defendants alleged that the word electromobile was an ordinary English word, meaning a car or carriage propelled by electrical energy, and that the word had not acquired the secondary meaning the plaintiffs said it had.

Mr. Justice Warrington gave judgment for the defendants, holding that the word "electromobile" was a descriptive term, and did not mean the goods of any particular person or company. From this decision the plaintiff company now appealed.

Mr. C. A. Russell, K.C., and Mr. J. D. Crawford (instructed by Messrs. Grundy, Kersland & Co.) appeared for the appellants, and Mr. J. D. Atkin, K.C., and Mr. Harman (instructed by Messrs. Donald, MacMillan & Mott) were for the respondents.

At the conclusion of the arguments for the appellants, and without calling upon counsel for the respondents,

Lord Halsbury gave judgment. He said the question was simply one of fact; and, viewed as a matter of fact, there seemed to him to be no reasonable probability of confusion between the two names. The degree or probability of confusion arising by people being deceived, depended very often upon the nature of the name. In this case, an injunction was asked to restrain a new company taking two words. "Mobile" was a good classical French word, and "electro" was applicable all over the world to electricity. Those names signified the qualities of the carriage. He did not believe that the word "electromobile," which was admitted to be a generic word describing a car driven by electricity and having the power of motion, had from 1902 been so specifically appropriated by any particular company, that it would lead people to be deceived if two companies having that word in their registered name were permitted to co-exist. The question was always one of fact. If the name sought to be restrained was one which merely conveyed, whether accurately or not, the qualities of a thing, it became extremely difficult, and required clear evidence to establish the fact that it would lead to deception. Proper names were distinctive enough, although, as a matter of fact, he did not deny that even a person might be restrained from using his own name, if in point of user a particular thing had become identified with that proper name. He was unable to disagree with the learned judge. Indeed, if he had been called upon to decide the case in the Court of the first instance, he should have arrived at the same conclusion as Mr. Justice Warrington.

Lord Justice Vaughan-Williams and Mr. Justice Bigham concurred.

The appeal was dismissed with costs.

Damages for Injury by Electric Wire.

It is reported in *Australasian Hardware and Machinery* that on October 2nd, at the Newcastle (N.S.W.) Circuit Court, before Justice Cohen, Nicholas Stephens, who was injured on December 12th last, as the result of coming into contact with a "live" electric wire, was awarded £325 as compensation. One of the corporation lighting wires broke during a storm, and Stephens came into contact with it as he passed along the street in the dark. The claim was for £500, and the action was defended by the Colonial Mutual Insurance Co., which had insured the Newcastle Council against loss.

Postmaster-General *v.* Watford Urban District Council.

Sitting in the King's Bench Division of the High Courts of Justice on Monday, the Railway and Canal Commissioners—Mr. Justice A. T. Lawrence, the Hon. E. Gathorne-Hardy and Sir James Woodhouse—had before them the case of the Postmaster-General *v.* the Watford Urban District Council, which raised the question of the respondents' right to require the appellant to lay telephonic cables underground to avoid inconvenience to traffic, instead of carrying them overhead.

The Solicitor-General (Sir Wm. Robson, K.C.) and Mr. Casserly appeared for the appellant, and Mr. Moon, K.C., and Mr. Munro were for the respondents.

In presenting the case of the P.M.G., the Solicitor-General said that the dispute first came before the County Court Judge of the district in May last, but the P.M.G. being dissatisfied with his award, it was referred by the statute to the Court whose duty it was to hear and determine the matter as it were for the first time. The P.M.G. in March last asked the consent of the U.D.C. to the erection of telephone posts in certain streets or roads in Watford, and the U.D.C. intimated that their consent would be subject to the wires being put underground, and the question was whether their discretion in giving or withholding their consent was to be exercised solely with regard to their ideas as to what would be suitable to the locality, or whether they must consider the undertaking as a whole. If local authorities were allowed or encouraged to do what the Watford Urban District Council had done, and the P.M.G. was required to place various parts of his line underground here and there throughout the country, the efficiency of the line would be wholly destroyed. There were three points in respect of which the parties disputed. The County Court Judge decided in favour of the P.M.G. in respect of St. John's Road.

Mr. Moon, interposing, said that since the County Court hearing they had been able to agree with the proprietors, and had obtained the sanction of the Local Government Board to a loan for the purpose of widening Aldenham Road, and they would no longer contend that that portion of the wiring should be put underground.

The Solicitor-General said that was an important concession for which no doubt the P.M.G. was obliged to the local authority. There was, therefore, only the question of Queen's Road remaining, and it was largely one of cost. The P.M.G. proposed to put up painted poles costing £17, whereas a deflection taking the line underground would entail a cost of £112, a difference of £95. The length affected was 415 yards, and the poles would be 70 ft. apart, so that there would be some six or seven poles. The local authority had erected an overhead telephone line of its own for hire purposes in High Street, a much more busy street than Queen's Road, and he submitted that it was not unreasonable to infer that they ought to exercise the same discretion for the public at large, as they had for their own ratepayers. They were not entitled to say when they were dealing with their own property that the wires should be put overhead, and then when they were dealing with the property of the P.M.G. say they must be put underground. Between London and Manchester there were only four, and between London and Newcastle only three places where the line had been deflected underground. If every Council acted as the Watford U.D.C. had acted, the deflections would really make the carrying on of the P.O. telephone system impossible, because the cost of construction would be something like six times greater than at present. The local authority was not entitled to withhold its consent and to impose upon the P.M.G. a burden five or six times greater except upon some sufficient, clear, distinct and unmistakable ground. It must not be some fanciful or theoretical difficulty which would apply generally, but something real and substantial. The present population of Watford was about 37,000. Queen's Road varied in width from 35 ft. 8 in. to 41 ft., and the poles would be placed at the edge of the kerb in line with the lamp-posts. The County Court Judge did not seem to have considered the question in its larger bearings, but only to have considered Watford, and not the effect his decision would have if generally applied.

Mr. Justice A. T. Lawrence pointed out that it was the duty of the local Council to ensure the public safety and protect them from inconvenience.

The Solicitor-General: Yes, but not to the extent of preventing a locality from having a telephone service at all.

His Lordship: The point is whether there is real inconvenience or not.

The Solicitor-General: We say that balancing the inconvenience against the other considerations, there would be no inconvenience at all, any more than putting down an extra lamp-post.

Mr. Robt. Fenn Roberts, senior assistant engineer-in-chief of the Post Office, spoke of the property in Queen's Road as of a poor description, and said that he had had a census of the vehicular and pedestrian traffic taken. The pedestrian traffic for three days, including a market day and a day on which there was a football match, averaged 340 persons per hour at one point, and 356 per hour at another point, and the highest vehicular traffic was 105 in an hour one Wednesday, and 102 on a Saturday. Vans without horses attached were frequently allowed to stand in the road outside small shops. He declared that the proposed poles would occasion no inconvenience.

Mr. Moon, K.C., then opened the case for the respondents. He did not dispute that regard should be had to the undertaking as a whole, but he denied that, *prima facie*, the P.M.G. had the right to put the wires overhead, contending that, under the Act he had to get the consent of the local authority, guarded by an appeal to a local Court to determine whether, in any particular case, consent was unjustly withheld or not. They had the decision of the County Court Judge who sat at Watford, and who, presumably, knew of his own knowledge as well as from the evidence, whether consent ought to be given to an overhead wire or not, and his decision this Court was asked to set aside; but they must not be deterred from doing what was just, because other people might be encouraged to prosecute claims which were not just. It had to be remembered that the Post Office telephone system was not a national service, and that that section of the community which did not use the service were entitled to as much consideration as that which did use it. The case ought to be decided without reference to what the effect of the decision would be. He did not suggest that the cost of construction was not an element to be considered, but the question of the possibility of creating, by the example of Watford, greater cost elsewhere, should not be considered. The Court, on the other hand, ought to consider, and consider seriously, the object for which the wires were required. This was a line required for the purpose of giving communication to one customer in Clarendon Road, and there was a hope of getting applications from other customers in Queen's Road. It was for the purpose of effecting this object that the interests of the community in the street were asked to be sacrificed, and he thought the Court ought to take into consideration what the relative importance of the object was for which the line was wanted. Watford in the last 20 years had increased in the most surprising manner, and its development would be greatly accelerated when the projected electric railway from Euston had been constructed by the London and North-Western Railway Co. People coming from the south-western portion of the town would use Queen's Road to get to the station. The whole of the goods traffic of the London and North-Western now went along that road. Counsel emphasised the fact that the local authority had to consider not only what the present traffic was, but also what it was

ikely to be, and he asked the Court to come to the conclusion, having regard to the fact that Queen's Road was one of the main arteries of Watford, that they were right, and not unjust, in refusing their consent.

Evidence as to the considerable traffic of Queen's Road, and as the undesirability of the erection of the poles there, was given on behalf of the U.D.C. by its chairman, Mr. Sydney James Ellis, solicitor; Mr. David Waterhouse, engineer and surveyor to the Council; Messrs. Charles Brightman and Mr. Tucker, members of the Council; Mr. Robert George Norman, C.C., and Mr. Albert Cole, contractor, of Watford.

The Court reserved its decision, the Commissioners intimating that they would visit Watford and personally view Queen's Road.

Maynard *v.* London Electric Supply Corporation, Ltd.

Before Mr. Justice Lawrance and a Special Jury in the King's Bench Division on Monday, William Charles Maynard, who had been employed as a fitter in the service of the London Electric Supply Corp., Ltd., sued that company for damages for alleged false imprisonment and malicious prosecution. On January 31st last he was arrested on the charge of stealing two copper flanges, and taken to the police-station, where he saw two men in the employ of the defendant company. One of these men, who had since died, then said he had seen the plaintiff take the flanges. After being taken before the magistrate the plaintiff was committed for trial, but the grand jury threw out the bill against him. It was stated that the plaintiff had always borne a good character. The defendant company denied that the prosecution was malicious, and said that so far as any charge was made under their direction, they had reasonable and probable cause. After plaintiff had given evidence, his Lordship held that there was no case against the defendants to go to the jury, and entered judgment for the defendants with costs.

The Brown Patent Appeal.

[*In the matter of the Patents, Designs and Trade Marks Acts*, 1883 *o* 1888, *in the matter of Letters Patent, No.* 1,434 *of the year* 1899, *granted to S. G. Brown.*]

(*Concluded from page* 969.)

To a very large extent I can only expound from my own point of view the reasons Mr. Justice Neville has expressed in his judgment, for in one and all of them I agree. Now, the first claim is: "A tongue and a moving surface so as to make and break the circuit for the purpose specified." It is not denied that that claim is to be read subject to a disclaiming clause. The main point of attack, and in my opinion the most serious point of attack in the whole of this patent, is the attack made on Claim 1. It is said, with perfect truth, that figs. 8, 9 and 9A, are for all practical purposes a reproduction of the contact of Varley, which appears in fig. 11, of No. 1,867, of 1866, in the year 1889, and it was not disputed that 8, 9 and 9A may be called Varley's contact. It is also said in the judgment, though our attention was not markedly called to it, to have occurred in Callendar, and it is also said to have been described in Delaney, of 1893. That being so, of course if this claim is a claim for a tongue adapted to be moved by the arrival of signalling currents, a tongue at one end of a relay circuit, so as to make and break the contact, if that is the only thing—that is a bad claim. That has been foreseen because a disclaimer was put in, and the whole question is what is the fair meaning of the disclaiming clause? There is no magic about specifications. You have to look at the whole specification and see what it fairly means to the public, neither reading it unfairly to the patentee, nor unfairly to the public, who want to know what it means. The patentee said: "I find that when the moving surfaces are arranged as in figs. 8, 9 and 9A the use of a condenser or condensers as there shown, is essential to practical success, so that I make no claim to such arrangement excepting therewith." I have not paused to describe Varley's contact; it is a tongue which hangs free from the revolving drum; but he has said in so many words "the presence of a condenser is essential to that, and I make no claim to such arrangements excepting therewith." It is said that we are to construe that claim as meaning "I claim the combination, but I tell you to use it with condensers," and, therefore, though he has put in this disclaiming clause, he must still be construed to have claimed the combination as a combination independently of its use with condensers. I do not see why that is not a perfectly good disclaiming clause, or why it is not a perfectly good way of limiting the use of Varley's contact, as in figs. 8, 9 and 9A to its use with condensers, and I see a very good reason why it should not be put, as I at first thought by words inserted in the claim itself, but I think it is quite clear that Claim 1 really does cover the modification of the divided drum as well as the claim to figs. 8, 9 and 9A. Mr. Justice Neville has taken this view, and I do not repeat, but adopt his language. That being my view of the construction of the claim, it is now attacked from the point of view of novelty, and that there was no invention in applying condensers to such a contact as Varley used, and here, of course, we approach the difficult question, Is it only discovery or is it only invention? As indicated already in dealing with electrical machinery of this delicacy, rules cannot be applied as in the case of an overhead crane or ferro-concrete pile or to some of those machines which really do not admit of the refinement, and the result of the operation of which does not depend upon the refinement which these electrical inventions involve. Really I deal with the case on the evidence. I take Varley's contact to have been old; I take, of course, this to be nothing more than the Varley contact, but there is evidence on this part of the case which is very significant indeed. Mr. Boys, a most competent and fair-minded man, was asked: "Did you ever hear of the use of a condenser in connection with such a contact as Varley's contact? Is it true that you, a competent electrician, would see at once that this difficulty of getting the right amount of contact in order to pass the current successfully, would be solved by adding a condenser to the Varley contact?" He was also asked: "So far as you know was there anything in electrical knowledge at this date—not only in the books but in the general knowledge of electricians which would have led a person to suppose that placing condensers across these contacts would have so reinforced the contact, as to make these things practically useful for cable relays?"—"I can say, having made a large number of exceedingly and minutely delicate electrical experiments myself, so that I have known the difficulty of delicate contacts, this was entirely new to me. I never read of it till I read this specification again." I ask if that is not true, why is it not contradicted? This is not evidence of opinion but of fact, and if Mr. Muirhead knew that there had been any number of these experiments made, and made to answer by a condenser applied to such a contact, why was not the evidence given? The evidence of the critical expert who has never practically worked telegraphy is of no importance, if it be a fact, that people who have worked this kind of delicate instrument had not the least idea it could be cured by a condenser. But the evidence does not stop there. One ought to remember what the evidence is as to the difficulty. I am not going to read, but I wish it to be available for the purpose of my judgment being understood, the evidence on page 181. There is an answer of Mr. Brown's, where he said he had been working on this by experiments as to what, in his view, was the difficulty to be got over. It may be right, or it may be wrong; I do not say every electrician would agree; all I say is, it is evidence to show there was a great difficulty to be got over in connection with the amount of contact between this delicate tongue and the surface with which it was coming in contact. At page 248, in re-examination, Mr. Brown, in answer to question 2,047, indicates in a somewhat popular way why he thinks his invention had been successful in getting the proper amount of pressure or contact at the point. At page 295, in reply to question 2,176, Mr. Swinburne gives an answer which certainly does him very great credit, pointing out the difficulty there was in getting a proper contact with such an apparatus as 8, 9 and 9A, and the function performed or fulfilled by the condenser in that case, and all I can say is that dealing with Mr. Swinburne's answer there, I have no doubt in my own mind Mr. Justice Neville was perfectly right in coming to the conclusion that it required a very considerable amount of invention to ascertain and to predict, or to prove that a condenser would really do this work. Finally, on pages 420 and 421, Prof. Silvanus Thompson (and these are the only two witnesses called for the petitioner, Mr. Swinburne and Mr. Thompson) is asked at question 3,556 and the following: "With that exception you find in these publications no illustration of the use of a condenser with a sliding contact? (A) I do not think I do, I do not recall any," and then he gives a very clever explanation in answer to question 3,562, as to the difficulties to be overcome. He is asked: "Do you deny that Mr. Brown discovered that the use of a condenser in combination with the smooth sliding contact of high resistance would have the effect of passing a considerable current through it? (A) On the contrary, I think I have said that it is new, in so far as the sliding contact element is new, but it was perfectly well known that a condenser would improve a contact under not very different conditions. There are other things besides pecking conditions." That is the extent to which the evidence goes to show that it is what is called discovery, as compared with invention. I unhesitatingly support the view taken by my brother, Neville, that given that, the claim is to be construed as being for a combined instrument, in which a condenser is used with a Varley contact, it was an invention of very high utility, an invention which no electrician could predict by mere general electrical knowledge, and which require experiments, and until those experiments had proved successful, success could not be predicted; and, as pointed out in many able judgments in the Court of Appeal and the House of Lords, that is quite sufficient to support a patent, assuming as a result that the combination is, in fact, new, and as a result is useful. I therefore come to the conclusion that Mr. Justice Neville's decision on Claim 1 was correct. I ought to add that Delany, in 510,007 of 1893, had described the use of a condenser for preventing contacts from sparking.

I wish to say that I concur with Mr. Justice Neville in his view that that was not the same use of a condenser as Brown specified, nor was the condenser applied to the Varley contact for the purpose of preventing sparking or anything which can fairly be said to be analogous; it is applied to Varley's contact, in my opinion, as Mr. Brown said, in order to improve the contact for the purpose of receiving and sending forward the proper signals.

Mr. Justice Neville dealt with Claim 2 and Claim 1 together, but I propose to deal with them separately, as I think it is easier to do so. Claim 2 is for "a moving surface connected to one end of a relay circuit, and divided by insulating partitions into sections for making and breaking circuit with a tongue or tongues connected to the other end of the relay circuit for the purpose specified." Here again Mr. Walter pressed us, and Mr. Cripps pressed us to say that this claim was bad, because it included any moving surface. If that is

the fair construction of the specification, it really is not disputed that the specification is bad. If this is a re-claim of the old vibrator or the old shaker to prevent the contact point sticking, the claim is not worth the paper it is written on. I wish to say that throughout this case, it seems to me that although it was very long, yet Mr. Bousfield's cross-examination was most effective in bringing out the real points of the case, and I perhaps ought to say here, and I say it parenthetically, it will be noticed that I am giving judgment not having heard Mr. Bousfield in answer to anything except this second claim. I have very little doubt, and I hope that my judgment will be leniently considered from that point of view, that had I heard Mr. Bousfield, I might have been able to supplement what I have heard on other parts of the case, but, of course, it was not necessary for us to hear Mr. Bousfield if we fully understood the case, in order to make my judgment better than it would appear if I had not heard him. If this is a claim to any moving surface, Mr. Bousfield said in terms in the course of the argument in the Court below, we must disclaim; the patent is bad. I think, again, on page 344 Mr. Justice Neville has put the proper construction on this specification. He says it does not mean any contact. I think I cannot put it better than he did, and, as Mr. Bousfield argued before us, that it means sliding contact; we are not here trying the question what would be infringement and what would not be infringement, we are only trying the question whether or not this patent is to be held bad on the ground that it ought to be construed as including Delany, or something equivalent to Delany. Shaking contacts were old. The literature of this case demonstrates that shaking contacts vibrate, avoiding what has been called an undue amount of pressure and other difficulties in making the contact an effective one for its purpose—not making it too stiff or too close, but freeing the two surfaces which you wanted to free—was old. For myself, I attach very considerable importance to the fact that all through this specification, although it is true that the expression "moving surface" is used in the claim, the only thing I find is an illustration of one surface sliding over the other, as in the case of a drum revolving underneath the tongue, and nothing to indicate that a vibrating motion will do. The anticipations upon this were said to be Delany, of 1890, No. 3,839—I do not think I need refer to the actual passage. It was said, taking Delany, 510,005 of 1893, you find several very important things which anticipate, according to Mr. Cripps's argument, this Claim 2. You undoubtedly find moving surfaces in some senses. You find a tongue at Sheet 2, fig. 3, at the top of it; you find the tongue *r*2, which moves against screw stops *c*5 and *c*4, which screw stops are made to tremble or vibrate under motion, and you find on the same figure a tongue, No. 4, which comes in contact with a surface, which is divided into insulated and uninsulated portions, which tongue vibrates on the surface, and I agree that this matter requires to be carefully considered. You find the description at page 2, lines 78 to 106, which showed that it was vibrating in order to remove the liability to stick. You find at page 3, from line 75 down to the bottom of the page, a description of his other form, in which he says: "The automatic action of the electro-magnet 8^1 imparts vibrations to the contact arm 4, not only preventing welding friction or sticking between its contact point and the contact *c*, c^1, c^2, but by reason of such vibrations ensuring a minute rubbing action between the contact faces, which improves the electrical contact." There is the same thing at the top of page 4. Then in Claim 15 he claims: "The combination with the contact arm of an electrical instrument and the contact or stop against which it works, of means for imparting to one of the said parts, fine vibration parallel with the face of contact to prevent welding or sticking"; and Claim 16, "The combination with the contact arm of a telegraphic instrument, and the stops or contacts against, or upon which it works, of means for imparting to the arm or contact fine vibrations parallel with the face of contact." Those two claims were said by Mr. Walter to be the enunciation of the very thing, and it is upon this part of the case that I certainly have received very material assistance from the very brief, but able, argument of Mr. Bousfield. He points out that this is one of the instances which, strangely enough, is referred to by Mr. Muirhead in that very clever summary of his: "It has been attempted before to utilise the signal core of Kelvin's siphon recorders to operate relay tongues." Mr. Bousfield showed us that the scheme of Delany for this purpose was to put a very fine wire through the siphon recorder tube, and then to use the succession of dot operations of that siphon recorder to operate his relay, or, in other words, so far as it is an enunciation of what was invented, it was improving the electrical action where you had a tapping operation moving with great rapidity, resulting in a series of dots or marks. Speaking for myself, I cannot possibly come to the conclusion that any competent electrical workman would have had any real glimmering of Brown's invention from what Delany has described. I do not refer to what was graphically said by a great judge on this kind of question as to the amount of ingenuity that is brought to bear on anticipations, and the minimum of intelligence which is applied to the construction of specifications which it is sought to upset; but, looking at this thing perfectly fairly, can I possibly say that Mr. Justice Neville is wrong when he has come to the conclusion that persons looking at Delany and Varley, which failed, would be led to make this successful electrical machine from the point of view of improved contact by the relation of the moving tongue to the surface either by means of the condenser, when you have 8, 9 and 9A, or by means of the sliding or the divided and partially insulated surface underneath the tongue in Claim 2. The actual combination in Claim 2 is not suggested, as a whole, to be old; it is suggested that people ought to have done it before. I will only refer to, I will not read again, the passage from Mr. Muirhead's specification, which, to my mind, is a very striking commentary. I, therefore, come to the conclusion that Mr. Justice Neville was perfectly right in regard to Claim 2. I am not impressed with that model which we have seen. That model was made after Brown's invention. I think as Mr. Justice Neville has said—it was a model produced which purported to be in accordance with Delany's specification, which Mr. Swinburne thought would work, though not as well as Brown's. We remember that Mr. Judd said all these delicate electrical instruments have to be most carefully looked after to see that they will work at all and to keep them in good working order, and when we know we are dealing with a very difficult problem, I should like a good deal more explanation as to how that model was made, and by whom it was made, before I came to the conclusion that it was a fair representation of what a skilled workman would make with nothing but Delany's specification before him. If that model was made by Mr. Muirhead, I can understand it perfectly. However, I do not know whom it was made by or under what circumstances. I now come to Claim 3. That is an entirely different part of the invention; it is that part of the invention which relates to the improved receiver as distinguished from the improved contact through which the current which operates the relay circuit is sent. It is a claim for "a receiving instrument short-circuited through a closed-circuit inductive coil for the purpose specified." In connection with that you must read the second part of the disclaimer. "I wish it to be understood that I do not intend my claims to include an inductive coil or magnetic shunt unless said coil or shunt possess the characteristics respecting its high self-induction and moderate resistance above stated, and unless said coil or shunt be used for submarine cables to shunt the receiving instrument under which conditions the usual receiving condenser or condensers might as aforesaid be dispensed with." A great deal has been said that Mr. Brown contemplates condensers being used or condensers not being used. It is quite plain that he did think in one part of his specification that you might dispense with condensers; it will not make the invention any the less valuable if it is found practical to use it without condensers; he indicates condensers may be used; it is not inconsistent with what he thought, that you might dispense with condensers; it does not make the specification bad unless he has in some way made it bad on the fair construction of the specification. I must here, perhaps, consider Claims 3 and 4 together to a certain extent. The particular thing that he had described as far as this is concerned is described at page 3, line 33, where he says: "Another feature of my invention consists in short-circuiting the receiving instrument by an inductive coil or magnetic shunt. It is important that these coils or shunts shall possess high self-induction with but moderate resistance, and for this reason I construct them of induction coils having closed magnetic circuits." Then on page 7, line 40, "Condensers usually placed in series with the line are not shown, as such condensers need not necessarily be employed when using the aforesaid magnetic shunt. The resistance of the magnetic shunt L is much less than that of the receiving instrument R, for instance, the resistance of the former may be, say, 30 ohms, and that of the latter, say, 5 ohms. The result of the arrangement is that all slow impulses flow through the magnetic shunt L and leave the receiving instrument R unaffected, and all sudden impulses such as the line signalling currents are assisted by the magnetic shunt L, and therefore affect the receiving instrument R. A varying zero in the receiving instrument, such as is due to slow irregular currents, is thus prevented. I had a great deal of difficulty in appreciating this. To my mind it was an exceedingly difficult problem, a most interesting subject, and when one considers what had been done before, the mere statement of it seems to me to show that the particular device for an improved magnetic shunt that Mr. Brown has specified involves very high powers of invention, and if successful was a great departure. I may just say, so that my observations may be understood, how it strikes my mind. I liken it for the moment to water. I understand that Mr. Brown, or anybody else approaching this problem, wants to arrive at this result; that supposing you have got a signalling apparatus which is in the line of a small pipe, and you want to get rid of disturbances, you have passing out of such pipe a short distance from the receiving apparatus a very large pipe or a much larger pipe; I will not say 30 to 500, but that sort of variation. And the people say, if you let a current flow down which is going slowly, it will find its way round by the wide mouth, so that it will not get effectively down to the receiving instrument. Then, if you have a sudden rush, it will go by the mouth of the wide pipe, and get to the receiving instrument. I daresay I have not expressed it correctly to an electrician, but I understand that was the character of the problem that had to be applied electrically, and this gentleman said: "If you have very low resistance in the shunt, you will get your weak currents, which will go through the low resistance part, and you will get your sudden impulses as he described, going forward and affecting the receiving instrument." The slow weak currents are prevented from disturbing the instrument, so as to make the zero vary, to make it less in a position to receive and less sensitive to the signalling current. This has been to a great extent dealt with by the previous specifications. The first is that of Varley, of 1862, and the passage is at page 8; I must first premise for a moment that Varley's idea was to divide the current into two about equal portions, one of which went to the shunt and the other of which went through the receiver. He says: "As these two channels offer the same resistance, the current equally divides, but as the half that traverses the relay in the opposite direction to the first current passes twice as often round it, the magnetic effect of the first wire is exactly neutralised, consequently no action would be produced in the relay were it not that the iron of the induction coil during the period of its magnetisation offers an obstruction to the passage of the current, and during this period of time more than one half of

the current flows round the second wire of the relay and produces a signal as before." He says: "Divide the current between the two channels; put a choking instrument, or something that will choke the one half in the one, then you will get the larger proportion going temporarily for an instant down the receiving instrument and get your signal." Nobody denies that that was a step in the right direction which Mr. Brown has gone further upon. The point is, is it invention to devise the improved method that Mr. Brown has described. As for Williams, upon which the greatest reliance was placed by Mr. Cripps and Mr. Walter (Mr. Walter telling us that Williams had done the same thing, and done it exactly for the same purpose)—I cannot take that view. It seems to me that Williams had thought of dividing it equally. He put a closed horse-shoe magnet as the core of his electro-magnet, and he sent half the current round that, and he thought it would counter-balance the other half. Therefore, he clearly never had in his mind the whole problem that Brown has attempted to solve. Again, Sir Oliver Lodge says at page 6 of No. 9,712 of 1898 that he shunts the telephone receiver out "by a self-induction or choke coil *t*, as indicated in fig. 9, where the transmitter H is shown operated by one of the vibrating coils A, as in fig. 7, but its telephonic receiver is shunted by the coil *t* whereby the steady current is mostly conveyed, while its rapid fluctuations mostly go through the telephone." To his mind, his Lordship proceeded, it would be wrong to suggest that in such subject matter as these highly delicate electrical machines they were, after publication by a skilled man of his invention, to read into these previous specifications knowledge which the most able people, the most advanced electricians who were specifying never had in their minds and never thought of. Claim 4 was for an inductive coil provided with a means of initial excitation. It was attacked on the disconformity point on the ground that passages in the provisional specification limited and narrowed the invention or did not sufficiently indicate it. In his judgment, however, the provisional specification was ample to allow this fourth claim to be made. What the inventor meant by "initial excitation" was something which he said you could do preferably by an alternating current. In his judgment the learned Judge was perfectly right in saying that if the machine would work with an alternating current, the patent was not bad, because he had put in that current which he knew would work. Claim 6 was the case where across the "bridge" in duplex telegraphy was put a closed-circuit inductive coil in series with the receiving instrument. In his opinion it was impossible for them to say the learned Judge was wrong in saying that there was sufficient ingenuity when the combination (which had never been used before) did effect that useful purpose, which allowed the system to be used with curbed transmitters, the jars being cured. The last objection was to Claim 7, on the ground that fig. 4 was for a wheel divided into three sections, which did not do its work. It appeared that Mr. Brown's evidence had not been understood as referring to the discharge, and he did not think even Mr. Muirhead himself would assert that this patent should be revoked on the ground that there was not sufficient utility in the divided drum so as to make the patent bad. In his opinion, Mr. Justice Neville arrived at a right conclusion in all these cases. He had seldom known a case of this kind supported by such weak evidence, where there was upon the case for the petitioner such strong evidence of the great step in advance, of great utility, and of considerable ingenuity in meeting the difficulties which the patentee had to contend with. He thought the appeal must be dismissed.

Lord Justice Buckley arrived at the same conclusion. As regarded Claim 2, Mr. Bousfield had satisfied him that a moving surface in this specification was not synonymous with a surface not at rest, that it did not include a surface that was in motion only by way of vibration. Thus construed, the second claim, he thought, was not too wide.

Lord Justice Kennedy concurred.

The appeal was accordingly dismissed, with costs.

BUSINESS NOTES.

Cryselco Lamps.—We understand that the Midland Railway Co. have placed a contract with Cryselco, Ltd., for the supply of incandescent electric lamps during the year ending December 31st, 1908. The Great Northern Railway Co. have also placed a contract with the company for the supply of lamps during the six months ending June 30th, 1908.

Exhibitions of Electrical Apparatus.—On Friday last there were two exhibitions at which electrical apparatus figured prominently. One was that of the Electro-Therapeutical Section of the Royal Society of Medicine, and was held in the small Queen's Hall; naturally, the leading features consisted of X-ray tubes and the apparatus associated therewith. The annual conversazione of this Section, which was formerly known as the Electro-Therapeutical Society, was held at the same place in the evening. The other exhibition was that of the Physical Society of London, and was held in the Royal College of Science, South Kensington; it was interesting to observe the extent to which the electrical element pervaded the display, few of the stands being altogether destitute of electrical apparatus of one kind or another. Each exhibition lasted only for a few hours. Owing to the pressure on our space this week, for the present we must be content to give a list of the exhibitors, leaving more detailed notice for a future issue.

Electro-Therapeutic Exhibition.—Messrs. Siemens Bros. and Co., Ltd.; Marconi's Wireless Telegraph Co., Ltd.; K. Schall; H. Helm; Newton & Co.; W. Watson & Sons; Leslie Miller; A. Favre & Co.; Sanitas Electrical Co., Ltd.; H. W. Cox & Co.

Physical Society's Exhibition.—Messrs. The Cambridge Scientific Instrument Co., Ltd.; A. C. Cossor; Crompton & Co., Ltd.; Elliott Bros.; Everett, Edgcumbe & Co., Ltd.; Evershed and Vignoles, Ltd.; W. Clark Fisher & Wadsworth; Gambrell Bros.; J. J. Griffin & Sons; Leslie Miller; Nalder Bros. & Co.; Nalder Bros. & Thompson, Ltd.; Robt. W. Paul; James Pitkin & Co.; Ross, Ltd.

Brook Green Ball.—To-morrow (Saturday), December 21st, at the Brook Green Works, Hammersmith, from 7 to 12, will be held the Plain and Fancy Dress Ball of Robertson's Social and Athletic Club.

D.P. Battery Business.—We are informed that the D.P. Battery Co., Ltd., since the recent extensions of their works and the remodelling of the shops, have been enabled to deal more promptly with increased orders. In addition to having a plentiful supply of home orders for train lighting and telegraph and telephone purposes, they have just shipped a large storage battery for one of the latest Nile boats. Colonial and foreign orders include batteries for Australia, Canada, Italy, New Zealand, Mauritius, Aden, Zanzibar, and South Africa. Amongst the home orders for country house lighting, the company have secured the renewal next year of the storage batteries they installed at Wroxhall Abbey long ago in the early nineties, and last week the battery order for the Luton tramway station was placed with them. The company is now represented in Japan and its dependencies by Messrs. E. H. Hunter & Co., of Fenchurch Street, London, and Japan.

The Lyons Exhibition of 1908.—With reference to the notice appearing on page 911 of our issue of November 29th respecting an International Exhibition of Electrical Machinery, &c., to be held at Lyons in June, 1908, the *Board of Trade Journal* states that in view of the fact that an exhibition of applied electricity is to be held at Marseilles in 1908, the Lyonnese Society of Agriculture, Science and Industry have decided to confine the scope of the Lyons Exhibition to electricity in its application to agricultural purposes, which will differentiate it considerably from that at Marseilles.

Thermit Joints in Australia.—Messrs. Thermit, Ltd., London, inform us that their Australian branch has received an order for welding portions for 10,000 joints on the new tramway system being constructed at Adelaide. Thermit joints have already been used to a considerable extent in Sydney, and other systems in Australia, and we understand that this order is the result of the satisfaction given at those places.

Catalogues, Calendars, &c.—The Electrical Co., Ltd., Charing Cross Road, W.C.—Several new leaflets, giving illustrations and prices of their cast-iron ship and mill fittings, hall and lantern fittings, and portable drilling machines, &c.

Messrs. Hamilton Bros., 19, Waterloo Street, Glasgow.—Leaflet describing, and giving a price list of, their motor-starters for motors of from ½ to 7½ h.p.

The Holophane Co., New York.—The third number of *Holophane*—a monthly publication issued by the company's sales and engineering departments. Illustrated contributions on illuminating engineering points, chiefly concerning the Holophane system, appear.

The Hopkinson Gas Plant Co., Standard Works, Huddersfield.—24-page price list (No. 150) in which are given full particulars concerning the Hopkinson suction, suction pressure, and pressure-gas plants, for non-bituminous fuels. The firm intend to carry out only the highest quality of work in this class of business, with a view to avoiding failures—reliability, safety, simplicity and cheapness being the four claims that they set up. The firm has other lists of various classes of gas plant and engines in preparation, and these will be forwarded to anybody applying for them.

Messrs. Baxendale & Co., Manchester.—Leaflet relating to recent improvements in Nernst lamps.

Industrial Improvements Co., 2, Jewry Street, London, E.C.—Leaflets describing their water-seal automatic discharge valve or steam trap; one gives a list of users, among whom are a number of electricity works and electrical manufacturing companies.

Messrs. Moul & Co., 76 and 78, York Street, Westminster, London, S.W.—New catalogue (24 pages) containing illustrated descriptions, with prices, of their speed indicating and recording apparatus. These include various standard patterns of tachometers suitable for use by hand, direct-coupled or belt-driven, with any class of engine. For the hand tachometers the single spindle pattern has been adopted throughout, and very wide ranges are obtainable without altering any fittings on the spindles. Among the different types of tachographs are types E, F and G, which are claimed to be of special value in determining cyclic irregularity and efficiency of governor control.

Messrs. Alfred Herbert, Ltd., Coventry.—We have received a calendar for the year 1908. It carries with it a high-class quality impression—which is only what it ought to do coming from so reputable a firm. The upper half of each monthly sheet has a fine half-tone view showing some of the lathes, milling machines, and other tools made at Coventry; the lower half sets out boldly the month's days.

Messrs. Sperryn & Co., Ltd., Hospital Street Works, Birmingham.—Large postal card illustrating and showing prices of new tumbler switches, key-holders, lamp-holders and cut-outs.

Messrs. Archibald J. Wright, Ltd., Leyton Green Road, N.E.—Leaflets of their electrical novelties for Christmas.

Messrs. W. & R. Jacobs, 39c, King William Street, London, E.C.—Several new publications:—(1) A leaflet relating to the "Electary" accumulator; (2) a 16-page booklet (No. 123) in which are given particulars and well-executed illustrations of electric heating apparatus (convectors and radiators), also Leitner-Prometheus radiator lamps; (3) a stock list of iron screws; (4) a 24-page catalogue of electrical supplies, including wires and cables, ceiling roses, cut-outs, fuse and switchboards, main, tumbler and other switches, electric lamps, water-tight fittings, shades, and so on.

Messrs. C. A. Vandervell & Co., Warple Way, Acton Vale, W.—Twenty-four-page catalogue (bright red cover) setting out particulars, with good illustrations and prices, of their ignition accumulators, electric lamps, and accessories. Loose leaflets also received deal with their magneto-electric ignition outfits, and the C.A.V. synchronised ignition, while one depicts effectively in colours a C.A.V. accumulator of 40 ampere-hours' capacity supplied to Messrs. Humber, Ltd.

Messrs. Thomas Bolton & Sons, Ltd., of Mersey Copper Works, Widnes, have favoured us with a handsome pocket book and diary (Letts's) for 1907. It is very finely bound, has card and stamp pockets, insurance coupons, and altogether is a very convenient companion. Tabulated data concerning some of the firm's manufactures appear in the opening pages.

The Ebonestos Manufacturing Co., 22 and 24, Rosoman Street, Clerkenwell, London, E.C.—Advance copy of illustrated list of their Ebonestos insulators, bushes, caps, washers, handles, &c. There is a convenient finger index to the different sections. Practically every article stocked by the company is shown by drawings of actual size, and prices are also given.

The British Thomson-Houston Co., Ltd., Rugby.—Illustrated leaflet giving particulars and prices of their electric tea-kettles and hot-water jugs.

Schiersteiner Metallwerk, Berlin W. 30, Schwerinstr. 3,—Leaflet relating to the "Veritas" watt-hour-meter, for D.C. and A.C.

"Santoni" Flame Arc Lamp.—We are informed by Messrs. D. Santoni & Co. (1906), Ltd., that the action which the Westinghouse Co. brought against them in respect of the alleged infringement of the Bremer patent, in connection with the "Santoni" flame arc lamp, has been withdrawn; and we understand that application is to be made to the Attorney-General for cancellation of the Bremer patent.

On the other hand, we learn from the British Westinghouse Electric and Manufacturing Co., Ltd., that it must not be supposed that their claim has been finally settled in favour of Messrs. Santoni; the amendment of the Bremer patent has been already substantially allowed by the Comptroller-General, whose decision with regard to the details of the wording is awaited. As soon as possible thereafter, the Westinghouse Co. will proceed to enforce their claim.

Trade Announcements.—With reference to a note in our issue of last week, we are informed that Mr. John Sydenham is a consulting engineer and expert in *gas*, not electric lighting.

The general office of the Electrical Trades Union has changed its address to 26, Cannon Street, Manchester, where all communications should be forwarded after December 21st.

Messrs. W. H. A. Robertson & Co., Ltd., have started Lynton Works, Bedford, for the purpose of building auxiliary rolling-mill machinery of all kinds on up-to-date principles.

The works of The Electric and Ordnance Accessories Co., Ltd., Cheston Road, Aston, Birmingham, will be closed for stock-taking purposes from Saturday, December 21st, until Thursday, January 2nd. Goods can be neither received nor despatched during this period, though, of course, all urgent matters will receive attention.

We are asked to state that, notwithstanding the liquidation of the Electrical Publishing Co., Ltd., announced in these pages a few weeks ago, the publication of the *Electrical Magazine* is not affected. The magazine is still being conducted under the editorship of Mr. T. Feilden.

Dissolutions and Liquidations.—Kalgoorlie Electric Power and Lighting Corporation, Ltd.—A meeting is to be held at Broad Street House, E.C., on January 15th, to hear an account of the winding-up from the liquidator, Mr. H. J. Dixon.

Re D. Santoni & Co. (1906), Ltd.—Mr. H. Gordon Nordalys, chartered accountant, 13-14, Abchurch Lane, E.C., informs us that he has been appointed Receiver by the debenture-holders of the above company, and as such, he is managing and carrying on the business in the usual way under powers conferred by the debenture-holders.

Foreign Electrical Bleaching Patents, Ltd.—A meeting is to be held on January 20th to hear an account of the winding up from the liquidator.

A Large Switch.—Messrs. Drake & Gorham, Ltd., recently showed us a large switch intended for a panel for power and lighting extensions at the Maidstone electricity works, the panel having mounted upon it, besides other gear, one 2,000-ampere quick-break single-throw knife switch, and two 2,000-ampere single-pole change-over switches. These switches are made of two copper blades in parallel, each of 3 in. × ½ in. hard-drawn copper, the current density therefore being 666 amperes per sq. in., while the contact area of the blades is run at only 66 amperes per sq. in. The contacts consist of substantial gun-metal blocks, milled out to take the contact jaws, four in number (two for each blade), these being of hard-drawn copper 2½ in × $\frac{5}{16}$in. These are sweated into the contacts and fixed with three copper rivets going right through the blocks. The stems are of 2-in. diameter drawn copper, screwed and sweated into the contact blocks, with a copper rivet going right through them. The stems are of 2-in. diameter drawn copper, screwed and sweated into the contact blocks, with a copper rivet right through the block and the copper stem to ensure these being rigid. The current density in the contact blades is 640 amperes per sq. in. The heel contact of the switch is fitted with a ¾-in. bolt, with cupped spring washers, to ensure a good contact being made.

These switches have been made entirely at the company's works, 3, Felix Street, Westminster Bridge Road, where they also have in hand at present, amongst other work, seven additional panels for a large extension for the Bristol tramways; amongst the gear on these panels are:—Three switches of 2,000 amperes each (exactly similar to the one described above); three of 600 amperes capacity; three of 400, and six of 200 amperes, besides field-breaking switches, circuit-breakers, &c.

Book Notices.—"Telegraphen und Posttarif Unicum." A handy schedule of telegraph and postal rates and regulations of the world, as they relate to Germany. Cologne: O. Moll. 1908. Price 60 pfg.

"Practical Mathematics." By F. C. Clarke. London: Edward Arnold. 1907. Price 3s. 6d.

LIGHTING and POWER NOTES.

Arbroath.—The T.C. has accepted the terms of the company carrying out the provisional order for lighting the streets with electricity. The contractors offered arc lamps of 800 c.p. each at £12 per annum, with £2 additional if lighted the whole night, and for 1,000-c.p. arc lamps £14 per annum. It was understood that all expense for carbons and maintenance should be paid by the company for seven years.

Ashton-under-Lyne.—The T.C. has received from the L.G.B. sanction to loans amounting to £25,645 for electricity purposes, including £12,855 in respect of excess expenditure. The L.G.B. deducted £1,517 from the sum applied for, disallowing seven items, the largest of which were £497 outstanding debt on accumulators which have been sold, £750 in respect of a water-cooling plant contract, and £215 wages paid to permanent employés.

Aylesbury.—The B. of T. has revoked the 1906 electric lighting order.

Bradford-on-Avon.—Both the U.D.C. and the R.D.C. have passed resolutions favouring the revocation of the E.L. Order obtained in 1904, the undertakers (the Western Electric Distributing Corporation) having failed to carry out the requirements under the order.

Canada.—The reports of the Sub-committee of the Ottawa City Council appointed to confer with the various water-powers for electrical development to be purchased by the city was issued this morning. The feature of the report is the guarantee by the Metropolitan Power Co. to deliver power in the city of Ottawa at $10 per H.P.-year, and a recommendation that if the city so desires, the power may be purchased for $175,000 in its present undeveloped shape. A dam, however, is required to be built at an estimated cost of $200,000, of which the Metropolitan's share would be $114,000, the balance to be divided *pro rata* among three other power companies in the vicinity. By the building of the dam 26,540 H.P. could be developed, which would be quite enough for some years.

Cheadle and Gatley.—The B. of T. has asked the U.D.C. what steps have been taken to carry out the E.L. Order, 1900.

Continental Notes.—Italy.—The Municipality of Turin is undertaking the most extensive electrical service of any of the Italian local authorities. The work is now in progress, and will develop rapidly. A canal, starting on the right side of the River Dora Riparia, has a total length of 8,350 metres, nearly half of which is tunnelled. The total power available will be 12,800 H.P. on the shafts of the turbines. The power will be conveyed to Turin by means of overhead conductors, a distance of 60 km. The generating station is situated a little below the Giaglione Bridge across the river. The cost of the whole works will be about 9 million lire, and electricity will be sold at a price of 138 lire per H.P. per annum.

France.—Owing to a strike of gas and electric light employés, the City of Bordeaux has been in darkness for two or three nights. It is stated that the strike has been settled.

Coventry.—At the City Council on Tuesday, the Electric Light Committee recommended that the sanction of the L.G.B. should be obtained to the necessary loan, the Committee to be authorised to expend the sum of £10,000 on extensions of distributing plant, and the sum of £25,000 on the laying of new

mains in the extended area. Alderman West, Chairman of the Committee, explained that this was a portion of the large scheme for the extension of the works, and that part relating to the supply of motors already granted, had been exhausted. The Council unanimously approved.

Devizes.—The B. of T. has revoked the 1904 electric lighting order.

Dublin.—It has been agreed that an electricity supply committee, consisting of 10 members chosen from other committees, shall in future take charge of the City electricity undertaking. This work has previously devolved on the Lighting Committee, which in future will deal with public lighting alone.

Dundee.—The Electrical Contractors' Association and the city electrical engineer are still at variance on the subject of the pushing of the business of the department, and with particular reference to the department issuing specifications on behalf of customers. At a meeting of the Corporation Committee a request to meet the Association was refused.

Magdalen Green, one of the city's most popular parks, is to be lighted by electricity.

Edinburgh.—The condensing arrangements at the M'Donald Road power station are expected to be completed early next year. The scheme includes the sinking of an iron-lined shaft, 26 ft. diameter, to a depth of 35 ft. where it intercepts a 6 ft. 6 in. diameter main sewer running towards Leith. Screening arrangements are to be provided, and centrifugal pumps will raise the water (sewage) through four 18-in. pipes to the condensers. Sluices are provided, also special arrangements for dealing with sewer gas. It is estimated that the scheme will cost £5,000 to £6,000, exclusive of station plant, and that it will result in an annual saving of £1,100—£1,500 in coal and £450 in water.

Heston and Isleworth.—The U.D.C. having incurred a debt of £1,900 through undertaking free wiring of consumers' premises at the outset of electric lighting in the area, applied to the L.G.B. to sanction a loan to meet the outlay, but without success. The U.D.C. has decided to extend the lighting of the main road by substituting incandescent lamps by arc lights at an estimated expense of £413. Upon the report of the electrical engineer, the U.D.C. has also decided, in order to meet the increased load on the system, to lay a new main feeder, 2,000 yd. long, to the town of Hounslow at an estimated cost of £1,400.

Heswall.—The P.C. has, subject to the consent of the R.D.C., entered into an agreement with Messrs. Robinson & Carter, of Liverpool, for the establishment of electricity works in the parish. A company is to be formed with a nominal capital of £30,000, and energy is to be supplied for lighting at 5d. per unit and for power at 2½d.

Heywood.—A scheme for enlarging the electricity works is to be laid before the T.C. in a few days' time, the proposal having arisen owing to the increasing demand for electricity for both lighting and tramways.

India.—The Calcutta Electric Light Co. has been granted a licence by Government for the lighting of Barrackpore by electricity.

London.—The B. of T. has informed the Metropolitan Borough Councils by circular letter that it is imposing certain new regulations with regard to electricity supply at extra high pressure in substitution for those dated February, 1899. The regulations are divided into two sections, the first part containing provisions for securing the safety of the public in regard to high pressure mains, and the second for ensuring a proper and sufficient supply of electrical energy.

Islington.—In February, 1906, in consequence of the defective condition of the steam engine and insufficient boiler power at Caledonian Road Baths, six small electric motors were installed. The superintendent estimates that a saving of 33s. 6d. per week has been effected by the use of the motors.

Hammersmith.—The Electricity Committee is arranging with Messrs. Brown Boveri to supply a new turbo-generator winding in place of one burnt out and to re-new the old one at small cost.

Bermondsey.—The B.C. is appealing to the B. of T. not to discontinue the official auditing of supply company's accounts, as the Council is directly interested in capital expenditure owing to its ability to purchase after a term of years.

Greenwich.—The South Metropolitan Electric Light & Power Co. has appealed against an increase of assessment of £1,000, in respect of its new power station, and the Assessment Committee has agreed to let the matter rest till 1910. Counsel's opinion has, however, been obtained by the B.C., and it has been decided to apply for a mandamus against the Assessment Committee.

Paddington.—The appeal of the Metropolitan Electric Supply Co. against its assessment has been decided in its favour, and the Finance Committee of the B.C. is ascertaining the extent of the Council's liabilities in the matter.

L.C.C.—At the meeting on Tuesday the Council gave sanction to the borrowing by Hampstead B.C. of £8,155 for mains, transformers, house services and mechanical stokers.

Lowestoft.—The T.C. has applied to the L.G.B. for a loan of £661 for the provision of mechanical stokers at the electricity works.

Maidstone.—The T.C. has applied to the L.G.B. for a loan of £1,540 for electricity purposes.

Nairn.—The B. of T. has stated regarding the revocation of the E.L. Order, 1902, that it has deferred consideration of the matter to April 23rd next.

Ossett.—The T.C. has approved of an agreement to transfer the E.L. order to the Electric Distribution of Yorkshire, Ltd.

Oulton Broad.—A prov. order for E.L. is being applied for by Lowestoft T.C. No opposition is anticipated.

South Bank and Normanby.—A scheme for lighting the town by electricity is being considered by the U.D.C.

Surbiton.—The protracted L.G.B. inquiry into the application of the U.D.C. for sanction to borrow £20,000 for E.L. purposes was concluded on the 17th inst. Since the commencement of the proceedings last month, the above sum has been reduced to £11,500. Mr. Elvy Robb has opposed the application on behalf of the ratepayers, since the beginning of the inquiry.

Trowbridge.—The B. of T. has written to the U.D.C. intimating that as nothing has been done by the undertakers, the Western Electric Distributing Corporation, to carry out the E.L. order, it devolved upon the Board to consider whether the order should not be revoked. In reply to this, the Council has asked the Board whether, to avoid the delay which would be caused by another company applying for an E.L. order, the existing order could be transferred to some other company or firm who would be prepared to carry out the work at once.

Walton.—The Woking Electric Supply Co., Ltd., has informed the U.D.C. that it intends applying for powers to enable it to lay mains for the transmission of energy to the company's area of supply. When the matter came up for consideration, the clerk said Walton might benefit indirectly, because it might be possible for the Urban Electric Supply Co. to arrange with the Woking Co. for a supply of energy for the town. The question of consenting to the application was left to the Highway Committee.

Willesden.—Application is to be made to the L.G.B. for sanction to a further loan, for the purposes of the electrical undertaking, and amounting to £14,727. This sum includes the following items for prospective works:—Additional plant, £3,875; meters and indicators, £1,125; services, £2,550; extension of mains, £8,000. The balance of the £14,727 is required to meet excess expenditure on works for which sanction has already been obtained.

TRAMWAY and RAILWAY NOTES.

Barnes.—A noisy public meeting, called by the Ratepayers' Association, has been held, at which a general opinion against tramways of any kind in the neighbourhood was expressed.

Continental Notes.—Switzerland.—The Council of States has agreed to the scheme of the management of the Federal Railways for the construction of a second tunnel through the Simplon, and has voted the sum asked for in connection with the scheme in the railway estimates.

Italy.—A concession has been obtained to utilise 3,000 H.P. for operating electrically the railways of the Jura; work has been commenced at a suitable site near Sion, where a power will be obtained from the River Rodam.

Germany.—A company has just been formed in Cologne with the title The Kolner Automobil-Droschken-Gesellschaft to introduce a service of electric motor-cabs in the city of Cologne.

Coventry.—An extraordinary accident occurred on Sunday afternoon last. A car was descending a rather steep incline leading to a sharp curve, when it gathered speed and after rounding the curve successfully, though oscillating violently, it jumped from the metals and fell over on its side. There were only two passengers on board at the time, and they, together with the driver and conductor, escaped without any injury.

Glasgow.—Following upon a conference with the Sramway Committee of Clydebank T.C., a sub-committee of the Corporation Tramways Committee has agreed to recommend that a new bridge at Dalmuir be constructed, and the line to the burgh boundary there be proceeded with as early as possible. The bridge over the canal at Kilbowie will not be dealt with in the meantime, and investigations are to be made with a view to ascertaining whether an extension of the tramways by the southern fringe of Radnor Park is not possible.

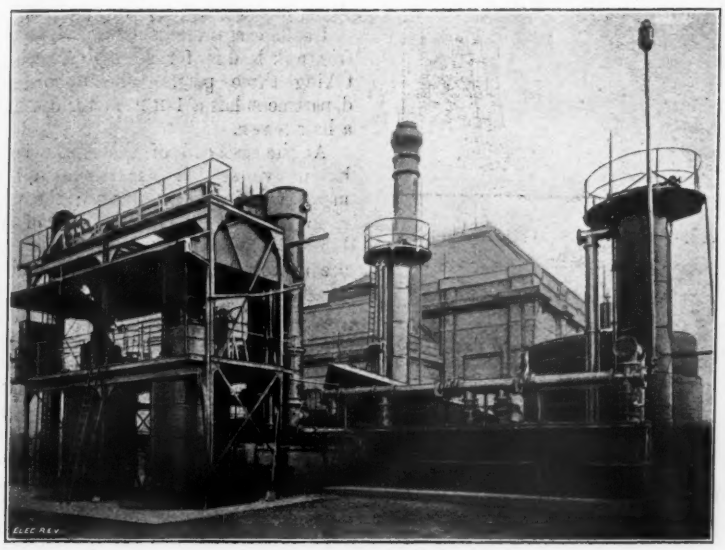
Twickenham.—The U.D.C. has offered to refund to the L U. Tramway Co. a sum of £2,000 deposited with its treasurer in 1900 as security for the due completion of the tramway in Twickenham. It has also agreed to meet the Heston-Isleworth and Southall-Norwood U.D.Cs. in conference as to the possibility of establishing a line of electric tramway from the Great Western Station at Southall, through Norwood Green, Heston, Lampton, to Hounslow, and thence by way of Whitton to Twickenham.

(*Continued on page* 1019.)

ELECTRICALLY-EQUIPPED RAILWAY SHOPS IN THE ARGENTINE.

(The Liniers Workshops of the B.A. Western Railway.)

The new workshops of the Buenos Ayres Western Railway are situated on the main line, about 14 kilometres from the centre of the city and about 10½ kilometres from their terminal station in Buenos Ayres at the Plaza Once de Setiembre.



View of the Mond Bituminous Producer Gas Plant.

These workshops comprise coach and car-building and repair shops, locomotive-erecting shop, boiler, smith, general machine and wheel-turning shops, iron and brass foundries, copper, tinsmiths', painting and varnishing departments, sawmill, and buildings for the construction and repair of steel-frame cars, besides extensive depôts for the storage of both rough and finished timber, as well as a large coach shed, section store house, oil depôts, &c.

The machinery throughout these works is electrically-driven on the three-phase system at 440 volts. Power is furnished from a central power station, which, in addition to supplying electrical energy for power and light, furnishes compressed air to operate pneumatic tools, air lifts in artesian wells, and for other purposes in the works.

The contractors for the complete electrical and gas engine and producer plant, &c., were the British Westinghouse Electric and Manufacturing Co., Ltd.

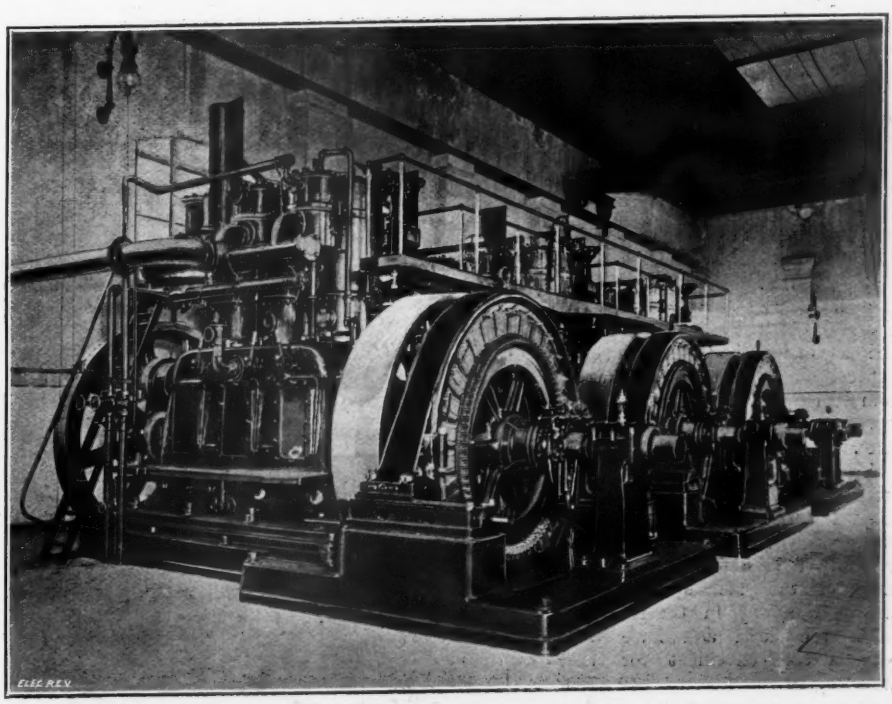
The grounds cover approximately 57 acres; the company builds coaches, wagons, &c., and erects rolling stock imported from England and the United States, the shops having a complete plant for this purpose. The locomotive section is equipped with machinery for the erection and maintenance of all locomotives, but not for building them.

To the left on entering the main gate is the office building, while to the right are the restaurant and workmen's dining room. In the time-keeper's office is an electrically-operated recording clock which marks on a tape the time at which the watchmen make the visits on their beats.

The works are divided by a wide central avenue, which runs across the yard at the main entrance, the west side being devoted to the wood-working departments, coach and car building, store houses, &c.; the east side containing the metal-working departments, locomotive erecting and repair shops, water works, and power plant. Like most railway shops, the buildings are of only one storey, and necessarily scattered, owing to the lines of tracks laid all around them.

The west end of the works is devoted to the wood-working departments, the stores being provided with an electric walking crane of 3 tons capacity operated by a 6-H.P. induction motor.

The car-building and repair department has 10 tracks passing through it; at the east end of the building the tracks pass on to a motor-driven traverser which serves this group of buildings.



Westinghouse Gas-Electric Generating Plant in the Power House.

The little machinery here required is operated by a 5-H.P.

F

View in the Main Machine Shop.

motor. The saw mill, carpenters' shop, coach-building and repair department, upholsterers', tinsmiths', store room, &c., are grouped together in one building, but are separated by interior division walls. These departments are served by an electric traverser or transport table which runs across the whole width of the yard, crossing main lines and through tracks. The traverser is 70 ft. long, capable of taking one of the longest coaches or several shorter vehicles, and has a carrying capacity of 45 tons. There are four sets of carrying wheels, one set of which is keyed to a long shaft receiving motion through gearing from a 10-H.P. Westinghouse induction motor. A pole at one end carries the current collectors, which take energy from three trolley wires. These rest on brackets attached to cable poles.

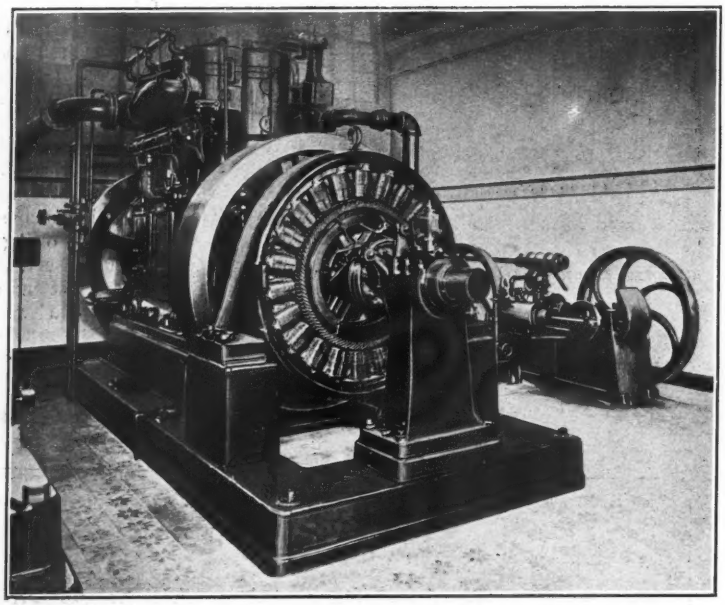
A system of individual motor drive is, to a large extent, adopted in the saw mill, because of the intermittent working of the different machines. Most of the motors are placed out of the way in concrete pits below the floor, and have their auto-starters convenient for those attending the machines. The motor equipment comprises 23 motors aggregating 307 nominal H.P., the largest being 60 H.P., and the smallest 3 H.P.

Energy is delivered to the woodworking departments, comprising saw mill, carpenters' shop, coach and wagon-building and repair shops, by two three-phase lines each composed of 166,000 c.m. cables. The motor circuits in the saw mill are brought to two distribution boards which are furnished with main fuses and switches for each circuit. The cables between distribution boards and motors, when they run under the floor, are in iron piping, and when they go overhead or along walls are carried on porcelain clamp insulators.

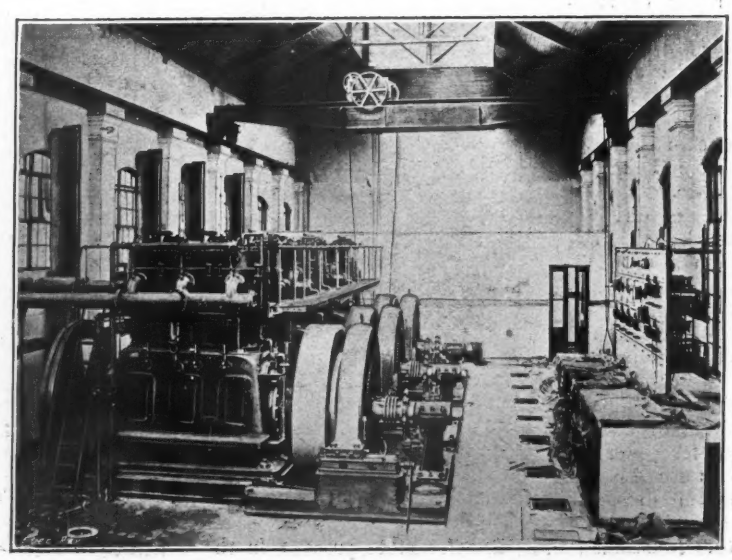
In the carpenters' shop are three electric tank heaters for glue pots, each one taking three pots. The upholstering department has a 1-H.P. motor operating a hair teaser.

At the east end of the works is the locomotive section as well as all the metal working departments; the wheel shop occupies the west end of this block of buildings. Its machine tools are arranged along either wall, and are driven from two motor-operated line shafts. Two electrically-operated walking cranes traverse the full length of this shop and serve all machines. One is a rapid walking hoist of 2 tons capacity and is worked by a 5-H.P. motor; the other being of 4 tons capacity is operated by an 8-H.P. motor. The total power connected here is 56 H.P., including the two cranes.

Electric power is used in the blacksmiths' shop to drive blast fans for forges and furnaces, exhaust fans to take smoke away from the forges and furnaces, and



Westinghouse 75-kw. Gas Engine and Generator.



Interior of the Power House during Erection of Plant.

to operate forging machines, bolt and nut machines, punches, shears, hot and cold saws, &c. All the forges are Buffalo down-draught type, having all smoke flues underground. There are in this department four Westinghouse motors of from 10 to 40 H.P., aggregating 85 H.P.

This shop loads the air-compressing plant heavily, as it includes four pneumatic hammers, two of 6 cwt., one of 4 cwt., and one of 1 ton. Two air-receivers are placed here to equalise the pulsation caused by the intermittent working of the hammers.

Next to the blacksmiths' shop is the steel frame car and bogie shop, which has an electric walking crane of 5 tons capacity serving the whole length. This is operated by a 10-H.P. induction motor.

Alongside, and occupying the south side of this block, are copper and tinsmith's shops and electro-plating and polishing departments; the former has a complete equipment of machinery for pipe cutting, &c., driven by a 5-H.P. induction-motor hung from the roof truss, and the latter a plating dynamo and polishing machines driven by a 3-H.P. motor.

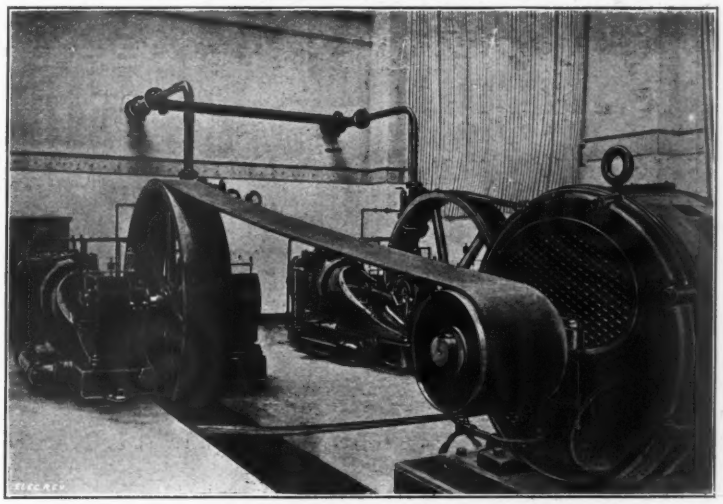
The general machine shop, on the north side between the smithy and foundry, has its machine tools belted to nine short line shafts, each of which is driven by an induction-motor carried on cast-iron brackets, secured to the walls 8 ft. above floor level. The auto-starters are conveniently placed, so that operators can handle them from the ground level. The motors all run at the same speed, 925 R.P.M., and drive the line shafts by two reductions of belting, the equipment comprising two of 5 H.P. and seven of 10 H.P., besides an electrically operated walking crane which serves all the large lathes and planers and is driven by a 5-H.P. motor. This department yields a fairly steady load, the current consumption being from 75 to 85 amperes per phase.

In the iron and brass foundry at the north-east corner of the block, adjoining the machine shop, the emery wheels, rattlers, &c., are operated by a 5-H.P. motor. A 5-ton electrically-operated three-motion overhead travelling crane, controlled from the floor, serves this shop.

The cupolas are situated outside the building on the north side and are of Stewart's economic type. The blast is supplied by two Roots blowers, each geared to a 15-H.P. Westinghouse motor running at 570 R.P.M.

The brass foundry is also provided with a light electric travelling crane operated by a 3-H.P. motor.

The foundries have, in addition to the electric cranes, motors of 3 to 15 H.P., aggregating 38 H.P. The load is very variable, owing to the machinery being intermittently worked.



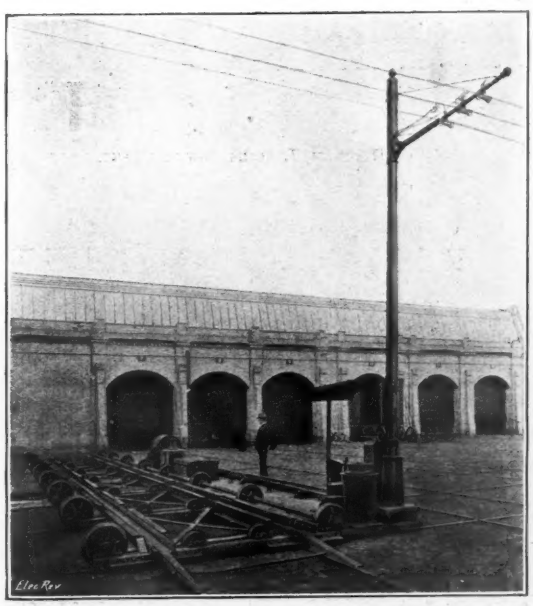
Motor-Driven Air-Compressing Plant.

The locomotive erecting shop is served by four 35-ton electric overhead travelling cranes, two in each bay, these are of 60-ft. span, and run the whole length of the buildings. The cranes are electrically equipped for all motions, and have a light hoist for loads up to 5 tons, which is operated by the same motor which runs the 35-ton hoist, either one being connected by a clutch on the crab carriage.

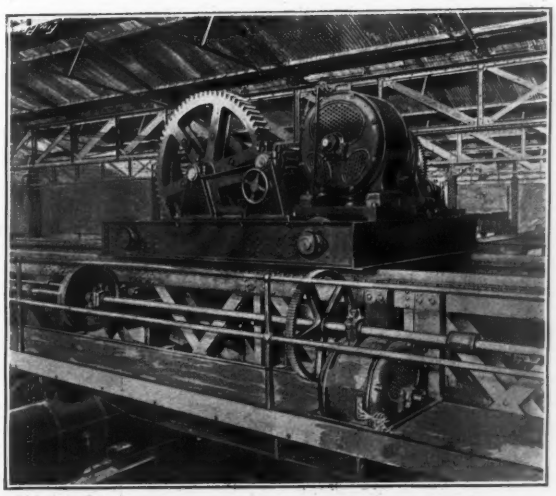
The Westinghouse crane motors are all of the three-phase type, and are operated at various voltages from transformers having a number of taps. There is, in this department, a very extensive distribution of compressed-air piping for the operation of portable pneumatic tools.

The boiler shop is spanned by an electrically-operated three-motion travelling crane of 25 tons capacity, similar to those in the locomotive erecting shop; the machinery is operated by two 10-H.P. motors.

The paint shop is a special building, in which a complete plant for artificial ventilation is installed; in the



Electrical Traverser for Long Rolling Stock.



Crab Carriage, 35-ton Travelling Crane.

paint-mixing department is a paint mill operated by a 1-H.P. motor.

View in the Loco. Erecting Shop, showing 35-ton Travelling Cranes.

There are two distinct water-pumping plants situated at the east and west wells respectively, and five of the six pumps are electrically driven.

The power plant is situated at the east end of the works; the gas producer plant, like most installations of the kind, is not placed under cover.

The power house building is of brick construction; there being a machine room for gas plant machinery, engine and dynamo room, air-compressor room, offices, workshop, and store room. The boiler house forms an extension at the east end, and is provided with a chimney 65 ft. high.

The gas plant consists of two water-sealed Mond bituminous producers, each capable of gasifying 10 tons of coal in 24 hours, together with the corresponding purify and cleansing apparatus. These are placed close together surrounded by columns which support the staging carrying the coal bunkers, coal elevator and conveyor, superheater towers and charging platform. The superheater towers or regenerators are placed at the back of the producers, between them and the building, and rise to a height of 40 ft. above ground level.

The gas leaving the top of the producer, passes through the superheater towers, washers, gas tower, gasometer, washing fans, sawdust scrubbers and condensers, to the engine main. None of the by-products are recovered as the price offered will not repay the expenses of recovery.

For the generation of the blast two blowers are provided, a steam-driven Roots blower, and a Korting blower, which latter is of the injector type.

The boiler house contains two locomotive-type boilers and a Worthington duplex pump supplying feed water through an exhaust steam heater.

Three Worthington duplex steam pumps circulate the water through the gas and air towers and settling tanks. A Roots blower for supplying blast to the producers, and gas-washing fans, are also provided.

The coal used in these producers for making gas is bituminous slack, and costs $6.50 per long ton at the works.

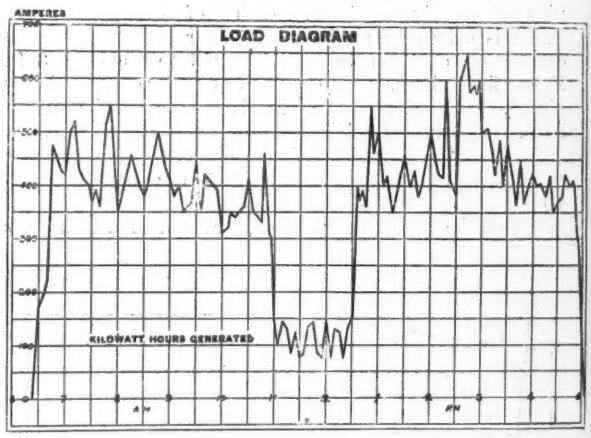
The engine room is equipped with Westinghouse three-cylinder gas engines, direct connected to Westinghouse three-phase alternators. These engines work on the four-cycle principle, having an impulse from each cylinder every two revolutions, and are so well known that no extended description need be given.

There are four units, three of which are of 250 B.H.P. coupled to 150-KW. three-phase generators and operate at 200 R.P.M. The fourth unit is a 125-H.P. engine coupled to a 75-KW. three-phase generator which operates at 272 R.P.M.

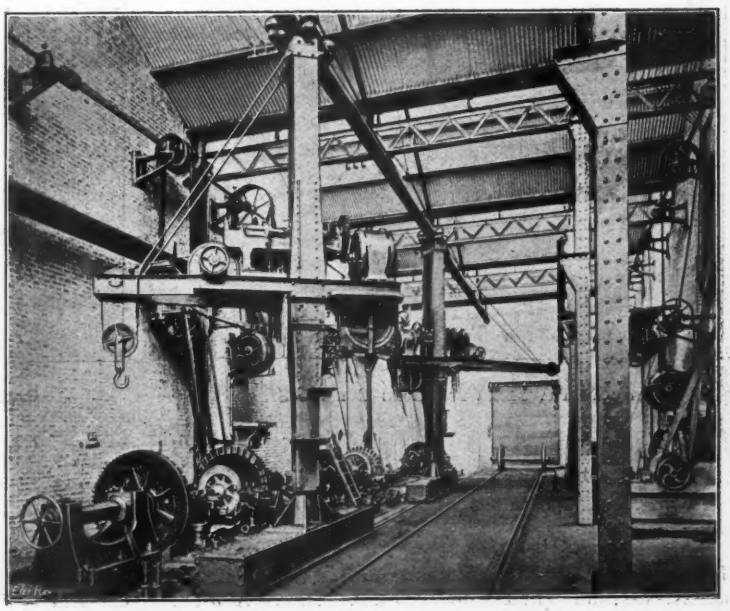
The alternators deliver three-phase current at 440 volts 50 cycles. They are operated in parallel; and, as will have been seen, the load, owing to the intermittent working of the shops, is very fluctuating.

The armatures are Y-connected, the neutral connection being brought out, and the collectors are of the skeleton ventilated type with four rings. The three terminal leads to the switchboard are 400,000 c.m. cable; the neutral being half that section.

A motor-generator set, consisting of a 60-H P. induction motor running at 700 R.P.M. coupled to a 40-KW., 125-volt dynamo, supplies exciting current for the whole station. To start up the plant current is taken from a steam-driven lighting set.



Load Diagram, Liniers Power Plant.



The Wheel Shop, showing Walking Cranes, &c.

907.

nded

which
-KW.
te at
-H.P.
phase
.M.
phase
They
will
the
s, is

the
out,
eton
The
oard
utral

g of
ning
KW.,
ting
start
m a

A motor-generator set consisting of a 2-H.P. induction motor direct-connected to a 1½-KW., 125-volt, direct-current generator, supplies continuous current for the operation of the watchmen's clock, electric fans, &c., during the day time.

The switchboard is built up of four dynamo panels, two feeder panels, one load panel, and one exciter panel; all being of white marble with chamfered edges. The dynamo panels are each fitted with a three-pole, double-throw, quick-break main switch, ammeter and switch for field circuit, and a main ammeter for each phase.

The feeder panels each contain two feeder circuits, with a three-pole, double-throw main switch, ammeter and recording wattmeter for each circuit.

At the end of the board, on a swinging bracket, are two total-output ammeters, and on the top of the switchboard is the synchroniser. The switchboard has duplicate bus-bars, and any dynamo and any feeder can be thrown on to either one. These two sets of bus-bars can be put in parallel by closing a single-throw switch on the load panel.

Push buttons on the board operate electric call and signal bells throughout the building. In the enclosure below the board are the arc and incandescent lighting transformers and compensators, series rheostat for fields of generators, &c.

All the cables within the building are placed underground. Those from the dynamos are carried in clay pipes and trenches. The outgoing feeders cross the building in a trench, follow up two of the columns and pass through the wall to the outside. In the trenches the cables are carried on porcelain insulators which are attached to iron cable racks, and, where they pass up the wall, are held by iron clamps having porcelain bushes.

There are two three-phase feeders composed of 260,000-c.m. cables, and two of 165,000-c.m. cables, besides several smaller ones. These are carried outside of the power house on brackets formed of channel-iron. There are four cables to each arm, spaced 15 in. apart, the brackets being spaced 18 in. apart vertically. All are anchored by strain insulators and tension screws.

From the corner of the power house the cable line continues, supported on steel poles with channel-iron bracket, the poles being spaced from 120 to 150 ft. apart.

The compressor installation consists of two Ingersoll-Sergeant duplex compressors, each driven by an 80-H.P. induction motor belted to the fly-wheel. The motors run at a speed when loaded of about 680 R.P.M., and the compressor at 150 R.P.M., the capacity of each being 350 cb. ft. of free air per minute. They are controlled by an unloading device which permits of lifting some of the valves at both ends of the cylinders as soon as the air reaches the set pressure.

The air supply is passed through a cooling tower, and delivered to two receivers for distribution.

The power house is illuminated by arc and incandescent lamps, arc lamps being suspended from ornamental cast-iron brackets attached to the columns.

Sparking current is furnished from a small D.C. dynamo driven off the line shaft of the gas plant machinery, as well as from the sparking dynamos on each engine, a plain throw-over knife switch being used to make the change.

There are two gas-engine-driven air compressors to compress the air into storage tanks for starting the large engines; each of these consists of a Campbell 8-H.P. four-cycle engine of the hit-and-miss type, driving a single-acting air-compressor cylinder. The air is compressed into four storage tanks of approximately 40 cb. ft. capacity each, at a pressure of about 190 lb.

The power distribution is all by three-phase circuits at 440 volts, 50 cycles. There are four principal feeders, whose load varies within the following limits:—(1) 75 to 200 amperes; (2) 30 to 180 amperes; (3) 0 to 200 amperes; (4) 150 to 220 amperes. The total number of motors installed is 93, of 1,071 H.P.

(To be continued.)

New Technical Institute.—A Technical Institute is to be established at Woking to serve the needs of the town and district, under the Surrey Education Committee, accommodation being provided for 700 students.

TELEGRAPH and TELEPHONE NOTES.

Telephotography.—The *Daily Mail* states that the first regular station for the transmission of photographs by telegraph was to be established at Munich on December 15th. A similar station is to be established in Berlin, and London and Paris will later be connected with a service.

Telegraphic Interruptions and Repairs:—

	Interrupted.	Repaired.
Cables.		
Curacao-Coro, Curacao-La Guayra, Curacao-Maracaibo } Closed..	Jan. 12, 1906 ..	..
Tarifa-Tangier	Jan. 18, 1904 ..	..
Port Arthur-Chifu (Closed)	Mar. 9, 1904 ..	..
Garachico-Santa Cruz	July 13, 1906 ..	..
Brest-Dakar	July 22, 1907 ..	..
Cueta-Tangier	Dec. 7, 1907 ..	..
Falmouth-Bilbao	Dec. 9, 1907 ..	..
Sierra Leone-Accra	Dec. 11, 1907 ..	Dec. 12.
Lagos-Brass-Bonny	Dec. 11, 1907 ..	Dec. 12.
Landlines.		
Puerto-Barrios	Aug. 9, 1902 ..	..

TRAMWAY and RAILWAY NOTES.

(Continued from page 1014.)

Colwyn Bay.—A resolution having been passed by the Council requiring the Light Railway Co., in the laying down of a further portion of the electric tram route between Llandudno and Colwyn Bay, to put wood block paving between the rails, Mr. S. Sellon, chairman of the tramway company in question, promptly wrote the Council, and with success. His letter was in terms of objection to wood blocks, but he offered to lay down the blocks subject to the Council maintaining the roadway for £60 per mile per annum, paid to the company. The effect of this communication was that the Council rescinded the resolution.

Dewsbury-Ossett.—The Ossett T.C. has applied to the B. of T. for a loan of £22,856 for the construction of tramways in the borough.

Ilford.—The Tramways Committee of the U.D.C. is in negotiation with traction corporations as to the system to be laid in Cranbrook Road. The Committee has accepted an invitation from the G.B. Surface Contact Co. to view the lines which are being laid by the L.C.C. in Bow Road.

London.—FULHAM.—The Works and Highways Committee has decided not to consider favourably the proposed L.C.C. tramway in Fulham Palace Road unless the Council adopts the conditions specified by the Fulham B.C. in June last.

L.C.C.—The Parliamentary Committee asked for, and obtained, authority for the seal of the Council to be affixed during the Christmas recess, to such memorials as might require to be presented in regard to tramway Bills in Parliament in the session of 1908, so that the Council might be heard before the Examiner and Standing Orders Committees. The Committee also mentioned that the Metropolitan Electric Tramways, Ltd., proposed to seek power for the extension of their existing tramways from Lock Bridge, Harrow Road, along Harrow Road to a point in that thoroughfare near Edgware Road. The existing lines of that system in the County of London were purchasable by the Council this year, and the Council had decided to exercise its powers in that respect. As the company had applied to the Council for consent to the introduction of the Bill, the Highways Committee was of opinion that permission might be given, and the Parliamentary Committee concurred in that opinion. The Committee, therefore, recommended, and the Council decided without discussion, to grant consent under seal subject to a satisfactory arrangement being arrived at with the company.

ST. PANCRAS.—The B.C. has decided that it can bear no part of the cost of constructing a new bridge across the Metropolitan Railway at King's Cross, to carry a double line of tramways for the L.C.C.; it has decided similarly in regard to the widening of Southampton Road for the same purpose.

Manchester.—The Tramways Committee is seriously considering the extension of the system in the growing industrial district of Clayton. Ratepayers there desire the extension. The work of constructing additional tramways in Moss Side will be commenced, it is understood, at an early date.

Middlesex.—A new tramway route from Lower Edmonton to the county boundary was opened on the 11th inst. It is between three and four miles in length, and connects with the existing tramway system, which communicates with that of the County of London.

South Lancashire.—It is stated that both the London and North-Western and Lancashire and Yorkshire Railway Companies are seriously contemplating carrying out the electrification of certain of their lines in the Manchester, Liverpool and central Lancashire districts respectively, but no definite information can be obtained regarding the pending developments.

U.S.A.—Mr. Alfred Smith, vice-president and general manager of the New York Central Railway, has been indicted for manslaughter following on the accident to an electrical train on February 14th last, when 23 persons were killed and 67 injured. According to the evidence, the instructor of the New York Central school for drivers obtained his knowledge of electrical engineering in a correspondence school; he estimated that four days was sufficient to turn a steam driver into an electrical one, on the company's two-mile experimental track.

CONTRACTORS' COLUMN.

OPENINGS FOR NEW BUSINESS.

ADLINGTON (LANCS.).—New Council school. H. Littler, county architect.

ALDERSHOT.—Married soldiers' quarters at Longmoor. H. B. Measures, Director of Barrack Construction, War Office, Pall Mall, W.

ATHERTON.—New co-operative premises. Secretary, Leigh Friendly Co-operative Society, Leigh, Lancs.

BARNES.—Block of shops in Upper Richmond Road for Neville & Crosse.

Eleven houses in Upper Richmond Road for T. Reid.

BELFAST.—Extensions and repairing shops, G.N.R. terminus.

Public abattoir contemplated by the Corporation (about £30,000).

BETTWS-Y-COED (PENMACHNO).—New Council school for Carnarvonshire C.C. R. Ll. Jones, architect, 14, Market Street, Carnarvon.

BLAYDON-ON-TYNE (WINLATON).—New place of worship. Liddle & Brown, architects, Prudential Buildings, Newcastle-on-Tyne; E. R. Davidson, builder, Blaydon.

New Council schools for Durham C.C. J. Monson, architect, 77, Westgate Road, Newcastle-on-Tyne.

BOLTON.—New cotton mill extensions for Messrs. Walker & Brown, Brownlow Fold.

BRISTOL.—New Presbyterian Church, lit by electricity. P. Munro & Son, architects, St. Stephen's Chambers, Bristol; Wm. Cowlin and Son, builders, Shatton Street, Bristol.

BROADSTAIRS.—Detached residence, Roseberry Avenue, for R. J. Spratling. West Cliff Road.

BROMLEY.—New fire station at Orpington. W. J. Winter, Council Surveyor, Station Road, Sidcup, Kent.

BROUGHTY FERRY.—Alterations to house for Dr. Gowans.

CADISHEAD (LANCS.).—Extensive works for J. P. McDougall, Manchester.

CARDIFF.—Fire Station and Operating Theatre at the Mental Hospital for the T.C. W. King & Sons, builders, Whitchurch, Cardiff.

CARNARVON.—Extensions to "Highfield," and erection of motor garage for Ald. Kay-Menzies. R. Ll. Jones, architect, 14, Market Street, Carnarvon.

CHADDERTON (near OLDHAM).—New Town Hall for the U.D.C.

CHESTER.—Extensions to Queen's School for the Governors (£4,000).

CHESTER-LE-STREET.—New Council Schools for Durham C.C. W. H. Knowles, architect, 25, Collingwood Street, Newcastle-on-Tyne.

COLWYN BAY.—Houses in Conway Road. J. O. Davies, builder, Colwyn Bay.

DARLINGTON.—New billiard room at Rosebank, Trinity Road, for J. J. Taylor.

Ice factory and carriage works in Valley Street North, for G. Dickinson & Son.

DARTFORD.—Houses (22) in Shenley Road. A. T. Ridley, builder, 27, Shenley Road, Dartford.

DUNDONALD (N.B.).—Extension to Fullarton School, Troon (£9,360).

DURHAM.—Hare and Greyhound Hotel, Bowburn, to be rebuilt, for J. Nimms and Son, Ltd.

FRASERBURGH.—New Central School for Cookery, Laundry and Manual Instruction. D. and J. R. McMillan, architects, 105, Crown Street, Aberdeen.

GLASGOW.—New Garden City. W. Inglis, 261, West George Street, Glasgow.

GREAT HARWOOD (LANCS.).—New Elementary School and Technical Instruction Block (accom. 900). H. Littler, architect, 16, Ribblesdale Place, Preston.

GRIMSBY.—New Head Post Office. Postmaster, Head Post Office, Grimsby.

HALIFAX.—Fire Brigade Station, three houses, stabling, &c., for the Halifax Flour Society, Ltd. W. Clement Williams, architect, 29, Southgate, Halifax.

HASLINGDEN.—Important extensions at Charles Lane Mills. Messrs. Carr and Parker (owners).

HASTINGS.—Additions to cooling tower for the Tramway Co. Kincaid, Waller, Manville & Dawson, engineers, Westminster, London.

HOUGHTON-LE-SPRING.—Fleece Tavern, East Rainton, to be rebuilt for Robinson Bros., Ltd.

HUDDERSFIELD.—Proposed additional premises for local Co-operative Society.

HULL.—New Co-operative premises. Hull Co-operative Society.

ILFORD.—Ten houses. E. T. Dunn, architect, 7, Roding Street, Ilford.

Additions to Salvation Army barracks. O. Archer, 101, Queen Victoria Street, E.C., architect.

ILLOGAN HIGHWAY (REDRUTH).—New Wesleyan Chapel.

KEARSLEY (near BOLTON).—Temporary Mission Hall. Rev. J. Morgan, Vicarage, Kearsley, Bolton.

KETTERING.—Important extensions to the Hospital for the Joint Hospital Board. Gotch & Saunders, architects, High Street, Kettering.

LEE.—Eight houses in Old Road. Hatch & Hatch, 62, Rushey Green, Catford, agents.

LEWES.—New hospital for the Victoria Hospital and Infirmary.

LLANFAIRFECHAN (CARNARVONSHIRE).—New Council school for the C.C. R. Ll. Jones, architect, 14, Market Street, Carnarvon.

LONDON (SHEPHERD'S BUSH, W.).—Alterations to Empire Music Hall. F. Matcham & Co., 9, Warwick Court, W.C., architects.

(SHOREDITCH).—Alterations and additions to Standard Theatre. F. Matcham & Co., 9, Warwick Court, W.C., architects.

(CITY).—New school (512 places) for Sir John Cass Foundation.

(KINGSWAY).—Veterans' Club. Major Arthur Haggard, Museum Station Buildings, 133-6, High Holborn, W.C.

(CATFORD, S.E.).—Six shops in Langley Road. Jas. Watt, Branley Road, Catford, S.E., builder.

(DEPTFORD).—Cape of Good Hope Hotel to be re-built (£2,000).

LONDON (W.).—Alterations and additions to six houses in five streets (£13,861). F. W. Foster, architect, Bedford Row, W.C.

(W.C.).—Buildings in Norfolk Street (£7,600). F. W. Foster, architect, Bedford Row, W.C. F. G. Minter, High Street, Putney, builder.

(QUEEN VICTORIA STREET, E.C.).—Re-construction of Century House. John Greenwood, Ltd., 12-14, Arthur Street, West London Bridge, builders.

(SOUTHWARK).—Extension of warehouse for J. Spicer & Sons. Rowland Plumbe, 13, Fitzroy Square, W., architect.

(SOUTHWARK).—Gymnasium at rear of mission hall in Collier's Rents.

(SOUTHWARK).—Warehouse in Long Lane for Dalton & Morgan. A. B. Stenning & Co., 121, Cannon Street, E.C., architects.

(HAMPSTEAD).—Additions to Myrtlewood. J. F. Parker, 18, Coleman Street, E.C., architect.

(HACKNEY, N.E.).—Eight shops and houses. Simpson Bros., 79, Rading Road, Homerton, N.E., builders.

(FINCHLEY).—Roman Catholic Church in Birkbeck Road.

(MARYLEBONE, W.).—Block of flats in Portland Place. F. T. Verity, 7, Sackville Street, W., architect.

(BERMONDSEY).—Warehouse for Spiller & Bakers, millers. W. Lawrence and Son, Canal Works, Waltham Cross, builders.

(S.E.).—Business premises in Boro' High Street (£2,100). V. Vagnolini, 33, Stirling Road, Clapham Rise, S.W., architect; Rice & Son, 15, Stockwell Road, Clapham, S.W., builders.

(TOTTENHAM).—Re-erection of shops, 492 to 500, High Road. Warran & Stupart, 78, Grand Parade, Green Lanes, N., architects.

(TOTTENHAM).—Additions to Maynard's factory in Vale Road. W. Stone, 2, Great Winchester Street, E.C., architect.

(FINCHLEY).—Eleven houses in Cavendish Avenue. F. Wheeler, 5, Staple Inn, W.C., architect.

(HACKNEY, N.E.).—Three shops. Rowlandson & Co., 267, Mare Street, Hackney, builders.

(KINGSLAND, N.E.).—Workshop. S. Hayworth & Sons, 108, High Street, Kingsland, builders.

(LAMBETH).—Buildings on site of Nos. 26 to 33, Hutton Road. Wm. E. Clifton, 7, East India Avenue, Leadenhall Street, E.C., architect.

(BROMPTON ROAD, S.W.).—Buildings. J. J. Wheeler, Woodford builder.

(BRIXTON).—Addition to store building. H. P. Wyatt, 18, Angell Road, S.W., architect.

(NORWOOD).—Development of estate between Cornwall Road and St. Saviour's Road. Fasnacht & Beale, 17, Old Queen Street, S.W., architects.

(LEWISHAM).—Row of houses for Building Estates and Properties, Ltd., 31, Walbrook, E.C.

(N.).—Fire station in Caledonian Road. W. E. Riley, superintendent architect, L.C.C., Spring Gardens, S.W.

(W.C.).—Building at corner of Exeter Street and Catherine Street. A. Boys & Co., 361, Birkbeck Bank Chambers, High Holborn, W.C., surveyors.

LUTON.—Houses and shop, Dallow Road, for Edwin Hillyard.

MANCHESTER.—Proposed co-operative laundries in North of England. Secretary, Co-operative Wholesale Society, Manchester.

(FAILSWORTH).—Development of Fields Estate, including erection of three cotton mills and 200 houses. F. G. Isherwood, J.P., builder, Oldham.

MANSFIELD.—New Church at Skerry Hill. L. A. Westwick, architect.

MARGATE.—Business premises, corner of Norfolk Road and Northdown Road, for E. F. Cobb.

MERSTHAM.—Residence, Rockshaw Road. W. H. Ferguson, Beckenham.

NANTWICH (WYBUNBURY).—Residence for C. R. Cooper. A. W. Moss, architect, Sentinel Buildings, Hanley.

NEWCASTLE-UNDER-LYME.—Two new Council schools at Audley. (Accommodate 300 and 400 respectively.) G. Balfour, Director of Education, County Education Offices, Stafford.

NORTHALLERTON.—New secondary school for North Riding of Yorks C.C. W. H. Brierley, architect, 13, Lendal, York.

NUTFIELD (SURREY).—Residence on Blackland's Estate. P. Wornham, builder, Brighton Road, Redhill.

PERTH.—Villas in Craigie. Wm. Gray, joiner, Perth.

Extension of Perth Academy to cost £2,000. Smart & Stewart, architects, Perth.

PRESCOT.—Important extensions at the workhouse for the B.G. (£9,000).

PWLLHELI.—New Council schools at Chwilog and Pentreuchaf. R. Ll. Jones, architect, 36, High Street, Pwllheli.

RHYL.—New pavilion near Water Street (£8,800). Smith & Maxwell, architects, Manchester.

RICHMOND.—Four houses and three shops. W. Vincent, West Park Estate, Kew Gardens, architect.

SHIPLEY (YORKS).—Extensive business premises in Ashley Lane, for P. Henderson & Co.

SIDMOUTH.—New police station, &c., for Devon C.C. (£1,775).

SOUTHALL.—Church of England and Vicarage (£8,800). Sir Arthur Blomfield and Sons, 6, Montague Place, W., architects; Longley, Crawley, builder.

SOUTHPORT.—New place of amusement on the foreshore (£6,000) for Helters, Ltd.

SOUTH SHIELDS.—Assembly hall and shops. J. Parkinson & Sons, builders, Blackpool.

STOCKPORT (REDDISH).—New doubling mill. New concern.

New factory at Mid-Reddish. Stott & Sons, architects, Manchester.

STRATHPEFFER, N.B.—New church and manse for the Rev. Mr. Johnstone.

SWANSEA.—Houses (33) for T. Davies.

TEDDINGTON.—Red Lion Hotel to be rebuilt, for Watney, Coombe, Reid and Co., Stag Brewery, Pimlico.

TURTON (BOLTON).—Extensions at Messrs. T. Appleton's bleach works.

WALKDEN.—Important mill extensions and alterations for E. Rothwell and Sons, cotton goods manufacturers.

New offices in Wilfred Road for J. L. Owen & Sons, builders, Walkden.

WARRINGTON.—New Post Office. J. Parkinson & Sons, builders, Blackpool.

WATERLOO (near LIVERPOOL).—Houses (14) in Brooke Road, for Smith and Davies.

WELLINGBOROUGH.—Important extensions to the Grammar School for the Governors. H. W. Miller, clerk, Hatton Hall, Wellingborough.

WHITBY.—Villa residence at Sandsend for Dr. Tinley. E. H. Smales, architect, 5, Flowergate, Whitby.

WHITEHAVEN.—Alterations to Old Clydesdale Bank. J. S. Moffat, architect, Church Street, Whitehaven.

WIDNES.—Important extensions to Mersey Copper Works, for Thos. Bolton and Sons, Ltd.

WORSLEY.—Proposed additions to Drywood Hall. Earl of Ellesmere.

CONTRACTS OPEN and CLOSED.

OPEN.

Austria-Hungary.—December 31st and January 4th. Tenders will be received by the K.K. Staatsbahndirektion at Prague (1) till December 31st for an electric travelling crane to lift three tons, required by the railway works at Laun; (2) till January 4th for an electric pump of a capacity of 70 cubic metres per hour, with suction plant and compressed-air tank, required by the water-power works at the station at Bodenbach. Forms of tender, &c., may be obtained from the K.K. Staatsbahndirektion, Abteilung 4, Prague.

Tenders are also being invited until December 31st for the construction of water-power works, including the supply of a turbine, generator and other plant required in connection with the erection of a hydro-electric central power house on the Koritnica-bach. Tenders to the K.K. Bergverwaltung, Raibl.—*Board of Trade Journal.*

Belfast.—December 28th. A double line of electric tramway, permanent way, electric masts, cables, wiring, lamps, &c., for the Belfast Harbour Commissioners. See "Official Notices" November 22nd.

Belgium.—The municipal authorities of Jemappe-sur-Meuse (Liége) have lately invited tenders for the establishment of a central generating station in the town for the supply of electrical energy for public and private electric lighting and power purposes.

Brussels.—December 31st. The Commandant du Génie requires tenders for the electric lighting of the Military School. Specifications, 1s. 8d., from 40, Rue de Reutiers. A deposit of £240 is required.

Buenos Ayres.—It is stated in the *Review of the River Plate* that the municipality has been calling for tenders for the construction of an asylum for beggars and incurables, to be fitted with electric lifts and electric lighting.

Finchley.—January 20th. One 350-KW. high-speed engine and dynamo, &c., for the Council's electricity works. See "Official Notices" to-day.

France.—January 15th. The municipal authorities of Lyons are inviting projects for the establishment of a combination refuse destructor and electric power generating station.

Kilkenny.—January 18th. Suction gas plants, gas engines, electric generators, battery, switchboard, mains, wiring, &c., for the District Lunatic Asylum. See "Official Notices" to-day.

London.—January 8th. The Metropolitan Asylums Board invite tenders for an electric lighting installation in the motor workshops and yard at a Fulham ambulance station. See "Official Notices" to-day.

Manila.—January 15th, 1908. Sewage pumps to be worked by electric motors are required by the municipal authorities.

Rawtenstall.—December 30th. Three steam dynamos and accessories for the Corporation. See "Official Notices" to-day.

Spain.—Tenders have just been invited by the municipal authorities of Villalba (province of Lugo) for the concession for the electric lighting of the town during a period of 20 years.

Tyrol.—The municipal authorities of Partschins (Tyrol), are about to invite tenders for the establishment of a central generating station in the town for the supply of electrical energy for lighting and power purposes.

CLOSED.

Australia.—NEWCASTLE.—According to *Australasian Hardware and Machinery*, Messrs. Noyes Bros., of Sydney, have the contract for the supply of additional generating plant at the Newcastle City Council's electric light station, for £1,994; delivery, 36 weeks.

Burslem.—The T.C. has accepted the tender of Callender's Cable and Construction Co., Ltd., for the supply of cable, at £459 10s.

Cape Town.—The tender of Messrs. Woods, Manahan and Co. has been accepted for the electric lighting of the South African Industrial Exhibition, to be held in Cape Town during the month of January next. The work comprises 10 arc lamps in the grounds and from 500 to 1,000 incandescent lights in the tea gardens and exhibition buildings.

East Ham.—The T.C. has accepted the tender of Messrs. Rickett, Smith & Co. for 250 tons of Newdigate rough slack coal for the generating station, at 14s. 3d. per ton.

Lancaster.—The tender of Mr. R. P. Wilson, electrical engineer, Lancaster, has been accepted for the installation of electric light in the new technical schools at the Storey Institute, Lancaster, the amount being £240.

London.—BERMONDSEY.—The B.C. Electricity Committee has received tenders for the supply of (1) 670 yd. ·5 sq. in. low-tension triple-concentric lead-covered cable; (2) 180 yd. ·5 sq. in. low-tension triple-concentric lead-covered and steel-armoured cable; (3) 670 yd. ·2 sq. in. low-tension triple-concentric lead-covered cable; (4) 180 yd. ·2 sq. in. low-tension triple-concentric lead-covered and steel-armoured cable:—

	(1)	(2)	(3)	(4)
Johnson & Phillips, Ltd. (recommended)	£644	£189	£292	£88
W. T. Glover & Co.	653	190	296	91
W. T. Henley's Telegraph Works, Ltd...	655	193	300	90
Siemens Bros. & Co.	656	194	298	90
Callender's Cable & Construction Co. ..	675	200	300	92

The following tenders were received for the supply of 220 yd. of 7/22 S.W.G. flat twin lead-covered cable, the prices quoted being subject to a discount of 2½ per cent.:—

Callender's Cable & Construction Co. (recommended).—600 min. ins. megohm grade, £8 5s. 3d.
Siemens Bros. & Co.—300 min. ins., £8 5s. 3d.
Johnson & Phillips, Ltd.—300 min. ins., £8 5s. 3d.; 600 min. ins., £8 12s. 1d.; 2,500 min. ins., £9 9s. 4d.
W. T. Henley's, Ltd.—300 min. ins., £8 5s. 3d.
W. T. Glover & Co.—300 min. ins., £8 5s. 3d.
British Insulated & Helsby Cables, Ltd.—600 min. ins., £8 12s.

STOKE NEWINGTON.—The B.C. received the following tenders for laying electric mains in certain roads:—British Insulated & Helsby Cables, Ltd.; W. T. Glover & Co.; W. T. Henley's Telegraph Works Co.; and Lahmeyer Electrical Co. The tender of W. T. Henley's Telegraph Works Co., at £623, has been accepted. Tenders were received from the following firms for electric wiring, &c., in private premises in the borough for 12 months:—W. J. Fryer & Co.; A. W. Gifkins & Co.; J. H. Golding; C. E. Taylor and Co.; Tilley Bros.; Wells, Rayner & Co. The tender of Mr. J. H. Golding was accepted.

L.C.C.—The Highways Committee of the L.C.C. proposes the acceptance, in connection with the reconstruction of the tramways in Caledonian Road and Seven Sisters Road, of the tender of the General Electric Co., amounting to £1,608, for additional sub-station machinery, consisting of one motor-generator. Three other firms were also invited to tender. These were the Electric Construction Co., who quoted £1,645, the British Westinghouse Co., £1,733, and Dick, Kerr & Co., £1,780. It is also proposed to accept the tender of Hadfield's Steel Foundry Co. for the special track-work, as an extension of an existing contract, and that of J. E. Spagnoletti, Ltd., for low-tension switchboard panels required at the Holloway sub-station, this being also an extension of an existing contract.

The following tenders have been received for the road-work and platelaying in regard to the proposed tramways between Hammersmith and Harlesden, which are to be on the overhead trolley system:—

	Tramway works.	Paving works for street widenings.	Total.
	£ s. d.	£ s. d.	£ s. d.
George Wimpey and Co... ..	32,685 10 8	6,392 12 11	39,078 3 2
Dick, Kerr & Co.	33,814 7 10	6,338 19 0	40,153 6 10
George Hay & Co...	33,936 14 4	6,443 8 1	40,380 2 5
W. Manders..	34,381 16 10	6,235 13 8	40,617 10 6
William Underwood & Brother	36,694 7 11	6,142 19 11	42,837 7 10
George Law	34,332 13 6	8,560 8 4	42,890 6 10
Robert W. Blackwell & Co. ..	36,577 8 4	6,772 13 6	43,350 1 10
John Mowlem & Co.	40,164 1 4	6,229 6 5	46,393 7 9
William Griffiths & Co.	39,536 8 7	6,898 7 2	46,434 15 9
National Elec. Construction Co.	39,170 15 10	7,416 16 2	46,587 12 0
Edmund Nuttall & Co.	40,472 19 10	6,530 9 1	47,003 8 11
J. G. White & Co...	41,751 16 0	7,284 14 10	49,036 10 10
Fry Bros.	41,434 10 7	8,656 14 9	50,091 5 4
W. Muirhead & Co.	43,318 1 10	8,304 0 11	51,622 2 9
J. Moran & Son	45 962 1 0	7,899 10 6	53,861 11 6
Engineer's estimate	39,839 0 0	7,568 0 0	47,407 0 0

The tender of G. Wimpey & Co. is recommended for acceptance for the tramway works, for the sum of £32,685, but a decision has not yet been arrived at in regard to the paving works for street widenings. Two tenders were submitted for the special track-work for these tramways:—Hadfield's Steel Foundry Co., at £1,666, and Edgar Allen & Co., at £1,773. The former is proposed for acceptance. The following tenders have been received for the supply of track rails for the Hammersmith-Harlesden tramways:—

Walter Scott, Ltd.	£14,546
Bolckow, Vaughan & Co.	12,893
P. & W. MacLellan	13,119
Barrow Hæmatite Steel Co.	13,262
Lorain Steel Co., U.S.A. (not to specification)	14,207
Steel, Peech & Tozer	14,444
Cammell, Laird & Co.	15,579
Continuous Rail Joint Co. (incomplete) ..	—
Engineer's estimate	12,137

The Highways Committee proposes to accept the tender of Walter Scott, Ltd., which is for 1,520 tons, and to extend the contract so as to include 1,080 tons of rails for the Aldwych-Embankment tramways and the lines in Caledonian Road and Seven Sisters Road. This will increase the expenditure from £11,546 to £19,691. Another contract is for 136 tons of flat-bottomed rails and fastenings for tramway car-sheds. The tenderers were:—

P. & W. MacLellan	recommended)	£1,072
Bolckow, Vaughan & Co.		1,081
Barrow Hæmatite Steel Co.		1,084
Steel, Peech & Tozer		1,134
Walter Scott, Ltd.		1,135
Cammell, Laird & Co.		1,262

The tender recommended becomes increased to £1,122 by the addition of £50 for contingencies. The undernoted tenders have been sent in for the delivery of steel underframes for 50 tramcar bodies:—

Hurst, Nelson & Co... ..	(recommended)	£1,975
Heenan & Froude		2,150
G. R. Turner, Ltd.		2,275
De Bergue & Co.		2,287
United Electric Car Co.		2,300
Mountain & Gibson, Ltd.		2,402

After the tenders were opened, Messrs. Bergue & Co. stated that owing to a clerical error their price should have been £1,937, but the Highways Committee has not felt able to consider the altered price.

The tender of the British Insulated & Helsby Cables, Ltd., amounting to £428 10s., has been accepted for the supply of 1,000 yd. of rubber-insulated and lead-covered cable for the tramways department.

HAMMERSMITH.—The Electricity Committee received the following tenders for the supply of ten electric motors for use at the premises of Messrs. Gwynnes, Ltd.:—

Two 50-H.P. motors, speed 500 revs. per min.

Vickers, Son & Maxim	£289

Speed 750 revs. per min.

Rhodes Electric Co.	£181
Electric Construction Co. (provisionally accepted)	188
Phœnix Dynamo Co.	188
Marryat & Place	190
Johnson & Phillips	191
Brush Electrical Co.	197
Fuller Electrical Co.	198
Bruce Peebles & Co.	217
British Westinghouse Co.	245
Lahmeyer Electrical Co.	245
Lancashire Dynamo Co.	263
Mavor & Coulson..	258

Speed 1,000 revs. per min.

Siemens Bros.	£182
Crompton & Co.	182
Langdon-Davies Co.	185
General Electric Co.	201
Lancashire Dynamo Co.	218
British Thomson-Houston Co.	218
Brown, Boveri & Co.	250

Four 30-H.P. motors, speed 500 revs. per min.

No quotations.

Speed 750 revs. per min.

Electric Construction Co. (provisionally accepted)	£248
Rhodes Electric Co.	256
Marryat & Place	269
Brush Electrical Co.	316
Phœnix Dynamo Co.	330
Bruce Peebles & Co.	342
Mavor & Coulson..	388
Vickers, Son & Maxim	427
Lancashire Dynamo Co.	428

Speed 1,000 revs. per min.

Electric Construction Co.	£232
Johnson & Phillips	265
Crompton & Co.	271
Langdon-Davies Co.	272
General Electric Co.	274
Fuller Electrical Co.	282
British Westinghouse Co.	298
Siemens Bros.	308
Lahmeyer Electrical Co.	325
British Thomson-Houston Co.	348
Lancashire Dynamo Co.	357
Brown, Boveri & Co.	400

One 18-H.P. motor, speed 750 revs. per min.

Phœnix Dynamo Co.	£57
Lancashire Dynamo Co.	70

Speed 1,000 revs. per min.

Rhodes Electric Co.	£44
Electric Construction Co.	45
Marryat & Place	47
General Electric Co.	55
Johnson & Phillips	55
Siemens Bros.	59
Lancashire Dynamo Co.	61
British Westinghouse Co.	61
Brush Electrical Co.	62
British Thomson-Houston Co.	63
Vickers, Son & Maxim	65
Fuller Electrical Co.	67
Bruce Peebles & Co.	69
Lahmeyer Electrical Co.	70
Brown, Boveri & Co.	71
Mavor & Coulson..	75

Speed 1,400 revs. per min.

Langdon-Davies Co. .. (provisionally accepted)	£37
Crompton & Co.	50

Three 10-H.P. motors, speed 750 revs. per min.

Phœnix Dynamo Co.	£135

Speed 1,000 revs. per min.

Rhodes Electric Co.	£99
Marryat & Place	105
Electric Construction Co.	108
Fuller Electrical Co.	111
Lahmeyer Electrical Co.	112
General Electric Co.	132
Lancashire Dynamo Co.	148
Siemens Bros.	154
Mavor & Coulson..	159
British Westinghouse Co.	163
Bruce Peebles & Co.	169

Speed 1,400 revs. per min.

Langdon-Davies Co. .. (provisionally accepted)	£94
Johnson & Phillips	105
Brush Electrical Co.	115
Crompton & Co.	121
Vickers, Son & Maxim	125
Lancashire Dynamo Co.	130
British Thomson-Houston Co.	133
British Westinghouse Co.	138
Brown, Boveri & Co.	153

The following quotation has been received from the British Electric Transformer Co. for the supply of transformers for use in connection with the Franco-British Exhibition:—Six 200-KW. transformers for reducing the pressure on the Council's supply, at £175 each; six 100-KW. transformers, three-phase, for reducing pressure of supply from the Kensington and Notting Hill supply station, £150 each, or for hire for eight months £280. In the event of the Council not taking a supply of energy from the Kensington and Notting Hill Electric Light Co. beyond the period of the forthcoming exhibition, the three-phase machines would probably, at the close of the exhibition, be no longer required by the Council. The Electricity Committee has therefore provisionally accepted the tender of the Transformer Co. for the hire of the three-phase transformers, and will purchase the six 200-KW. transformers. For the switchgear required for the purposes of the Franco-British Exhibition, the following tenders have been received:—

Ferranti, Ltd.—£1,077 8s. 6d., no generating station panels; delivery in eight weeks.
British Thomson-Houston Co.—£1,078 7s. 6d., no generator panels; delivery in eight weeks.
Cowans, Ltd. (provisionally accepted).—£1,154, including erection; delivery in ten weeks.
Ferranti, Ltd.—£1,277 16s. 6d., including erection; delivery in eight weeks.
Spagnoletti, Ltd.—£1,651 10s., delivery in eight weeks.

The engineer reported that Messrs. Cowans' tender was the lowest for the gear complete, the British Thomson-Houston Co. having omitted one board. Delivery is one of the most important points, and although Messrs. Cowans' delivery, it would be noticed, was not the best, the engineer understood that they absolutely guaranteed to complete the work by the time stated. The General Electric Construction Co., Ltd., is to supply, for £620, a motor-generator with an output of 150 KW., for use in connection with the supply to the Franco-British Exhibition.

Luton.—The T.C. has accepted the following tenders:—

D.P. Battery Co.—Traction batteries, £560.
Lancashire Dynamo & Motor Co.—Automatic reversible booster, £245.
Johnson & Phillips, Ltd.—Traction switchboard, £257.
W. T. Henley's Telegraph Co.—Laying 1,000 yd. of feeder, 15s. 9d. per yd. run.

Peterborough.—The T.C. has accepted the tender of W. T. Henley's Telegraph Co., Ltd., for the supply of cables, at £1,249 16s. 11d.

Sunderland.—The Electricity Committee has accepted the tender of Messrs. Ferranti, Ltd., for 81 consumers' meters; also that of Messrs. Crompton & Co., Ltd., for 22,000 pairs of carbons.

Yarmouth.—The T.C. has accepted the tender of Messrs. Geipel & Lange for the supply of carbons, at £3 1s. 7½d. per 1,000 pairs.

NOTES.

A Merry Xmas.—To every reader and friend of the ELECTRICAL REVIEW we wish a right Merry Christmas.

"E.R." Xmas Week Arrangements.—We shall be glad if our friends will kindly take note of the following special arrangements that have had to be made to facilitate the production of the issue of the ELECTRICAL REVIEW for next week. All editorial matters will have to be closed two days earlier than usual.

Correspondence and Urgent Articles should reach us by mid-day on Saturday, December 21st.

Late Business Items, News, Contract and other notes should be received in the course of Monday, December 23rd.

The Advertisement Department announce elsewhere that new copy and alterations to existing displayed advertisements should be received by them not later than Friday morning, December 20th; but official notices and small prepaid advertisements will be in time if received by 9.30 a.m. on Tuesday 24th inst.

Electricity in Australian Mines.—According to *Australasian Hardware and Machinery*, a Commission to inquire into the use of electricity in coal mines has been appointed by the New South Wales Government. The appointment is the outcome of complaints by miners that as the cables in the Hepburn Colliery fused at times and gave off sparks and flame, there would be danger of an explosion if gas were present. Seeing that safety lamps were in use in two sections of the mine, the men asked that the machines be withdrawn from those sections, or that some other motive power be used. The Australian Agricultural Co., who own Hepburn, refused to do this, and the mine was thrown idle. The Commission is now taking evidence in West Maitland in respect of the use of electricity as a motive power in mines, and particularly in those where gas is found. Judge Murray is president.

Appointments Vacant. — "B" class station supervisor (electrical) for H.M. Dockyard, Haulbowline, Co. Cork; armature winders for the electrical engineer's department at Devonport Dockyard; traffic superintendent (£250), also rolling stock superintendent (£130) for Halifax Tramways department; meter inspector for Kirkcaldy (30s.).

Simplex London Showroom.—On Tuesday last we had the privilege of inspecting the new offices and showroom of the Simplex Conduits, Ltd., in Charing Cross Road, London. Pressure upon our space compels us to defer publication of details until next week.

Tramcar Brakes.—According to a notice appearing in the *Journal* of the Light Railways and Tramways Association, the Committee on Brakes spent the better part of Saturday, December 7th, at the L.C.C.'s New Cross depôt, where a series of tests were carried out. The members satisfied themselves upon several important points, which they considered should be clearly demonstrated before completing their report. Every facility was afforded by Mr. Fell. A complete up-to-date set of recording instruments was available, and the results of the tests proved of the greatest value. Further meetings are being arranged for.

Photographic Arcs.—A German, named Kufferath, has invented a process of treating arc lamp carbons with a solution containing ½ to 1 per cent. of a mixture of yttrium and lead nitrates. The light obtained from these carbons is said to be rich in actinic rays, rendering it specially suitable for photographic work.

Late Legal. — Norwich Corporation *v.* Norwich Electric Tramways Co.—On Wednesday, in the King's Bench Division, Mr. Boydell Houghton mentioned to Mr. Justice Bray the above case. He said it was a case of an award, and was raised on a special case. His Lordship found in favour of the Corporation, and the company now desired to appeal. Some hundreds of pounds would have to be paid by the Tramway Co. to the Corporation, and the main part of the award was its future effect on the working of the tramway.—His Lordship directed the money to remain in the hands of the Tramway Co. pending the appeal.

Yet Another Tramway Association.—On the invitation of Mr. Fred Coutts, general manager of the Paisley District Tramways Co., a large and representative gathering of the Scottish tramway managers took place at Paisley on Saturday last, and it was agreed to form a small association, called "The Scottish Tramway Officials' Association," the members of which will meet three or four times a year for the purpose of discussing tramway matters. After the election of Mr. Dalrymple, of Glasgow, as president, and Mr. Coutts, Paisley, as secretary of the new Association, an interesting discussion took place on a short paper read by Mr. Dalrymple. At the close of the meeting it was agreed that the next meeting should take place in Edinburgh on May 8th.

The Value of Advertising.—We commend the following paragraph taken from the *Standard* of Wednesday, to the attention of Sir William Preece:—"The *Advertising World* has now been in existence for six years, and each year it has increased in interest. It claims to occupy the unique position of being the only independent advertising trade paper published in this country, as no printer, advertising agent, newspaper, or engraver has the smallest interest in its proprietary or any voice in its control. Its growth is a mark of its progress. The first number consisted of 32 quarto pages, and the present number contains 160 octavo pages. Those responsible for the conduct of the paper have produced a journal which should be of real assistance to the advertiser in dealing in a practical manner with the problems which constantly confront him, and by recording and reviewing all matters that pertain to the progress of advertising. Besides the numerous advertisements which appear in the present issue, the journal contains a great deal of literary matter bearing upon advertising. In one article some remarkable tables are given in reference to the volume of advertising in London daily newspapers during the past two years, and in another article an interesting symposium of the opinions of leading advertisers is given on the important question whether the public has become more responsive to advertisements."

Reinforced Concrete Pipe.—A paper read before the American Society of Civil Engineers by Mr. C. W. Smith in October last, describes the mode of construction of two pipes, 6,000 ft. long, to carry water under pressure. The pipes were circular in shape, 5 ft. 3 in. diameter, and consisted of concrete 7 in. thick, reinforced with ten longitudinal rods, and rings spaced 3 in. apart, of steel ⅝ in. in diameter. A movable form was used, pulled along inside the skeleton; the form carried a track to support the upper moulding plates giving the proper shape and thickness to the interior of the pipe, and as it was pulled along in short stages, stationary plates were inserted in its place, to maintain the shape of the invert and to support the upper plates left behind the form. When the concrete had set, the rearmost plates were removed and carried to the front. The outside lagging was of wood 2½ in. thick, in narrow pieces, held between iron ribs. After repairing small cracks, &c., the pipes were found to be sufficiently watertight, without special lining.

A Post Office Destroyed by Lightning.—A report from South Africa says that early on the morning of November 16th the Roodepoort Post Office was struck by lightning and destroyed by fire. The trunk cable was in the line of contact, and the wires inside the building were fused.

A Neglected Source of Energy.—A correspondent sends us the following cutting from a local paper:—"The flea is encased in armour like a medieval knight. It can leap 30 times its own height; it can draw with ease 80 times its own weight. Let man, proud man, think of these things before he regards the pulex with disdain. How many men can jump up 180 ft. in the air? And how many can pull a load of, say, 960 stone weight? An enormous force must be lost or wasted owing to our not having properly harnessed the flea. There are some seaside towns which could easily obtain from this source enough energy to light them by electricity and to run the trams also."

The Electrical Installation of the Royal Victoria Infirmary, Newcastle-on-Tyne.—In connection with the above article, appearing in our last issue, we have pleasure in adding that Mr. E. R. Dolby, M.Inst.C.E., of Dolby & Williamson, Westminster, acted in the capacity of consulting engineer, not only for the whole of the work described, but also for the steam plant and the heating and hot water system. The work in progress was carried out under the personal supervision of Mr. Dolby.

Lancashire Electricity Committees and Coal Trade Corruption.—A trade representative says that reports have lately been circulated to the effect that bribery (in a mild form) has been attempted by coal dealers, in electrical as well as cotton trade circles, in Lancashire. It is stated that engineers in municipal electrical works in various parts of south-east and central Lancashire have recently been approached by representatives of colliery firms, and offered certain inducements in the shape of Christmas gifts if they would recommend their coal. Private instructions are said to have been issued by certain Electricity Committees in the above-named areas warning their engineers against accepting gifts from colliery proprietors or coal merchants.

The Wisdom of Bob the Shiftman.

1. If a circuit-breaker comes out on night shift, wait; another may follow, and this will save you getting up twice.
2. If a fly-wheel burst and brings down the main steam-pipe, do not rush for the door; other collectors of fresh air will be using it. Try the window.
3. You look after the volts: the amperes will look after themselves.
4. Overloads are deceptive. Many plants will climb a peak, but they will not therefore walk along a plateau.
5. Never admit that the volts were back at eight o'clock last night.
6. When David said: "All men are liars," he must have been thinking of our junior's section of the log sheet.
7. No man is perfect. The engineer who repaired a broken crankshaft while the machine was running, still has to keep his hands in his pockets till his landlady has mended his braces.
8. If you are determined to switch in the 1,000 kilo. set exactly out of phase, make a job of it, so that no one else can do it for weeks.
9. The surprise of Jezebel when she was pushed out of the window was nothing to that of our volt boy when he hung his tea-can on the terminals of the main voltmeter.
10. A machine that won't excite itself very often excites the engineer in charge.
11. One of the disadvantages of mechanical stokers is that they cannot make a fourth at Nap.
12. Asking the chief for a rise, when the High Street manhole covers are flying about like kites, is asking for trouble.—Bob the Shiftman.

A State Electrical Monopoly in Germany.—The question of establishing an Imperial monopoly of electricity continues to engage attention in Germany, where statements on the matter are somewhat contradictory. It has been stated, for instance, that the utilisation of the water-powers in Bavaria is specially aimed at by the Imperial Government, but the Bavarian Government, which desires to retain the water-powers in that State for its own use, has made inquiries into the subject, and declares that the rumour of the introduction of an Imperial electrical monopoly is completely unfounded. On the other hand, other sources in Munich express a contrary opinion, and state they hear from Berlin that the problem is being seriously discussed in competent Government circles in the German capital. Apart from these opposing reports, it may be mentioned that Herr W. Plenske, of the Berlin University, has issued the results of his investigation of the question as a national economist. The author considers that State action would lie in the establishment of an Imperial electricity law based upon the monopolising of the production and supply and the provision of an Imperial Electricity Anstalt. If a monopoly is to be introduced, it should not be allowed to remain half-way. It would be, in his opinion, a false step to nationalise the existing electricity works "as such," and then continue them, for that would not enable the fulfilment of the promise to render electrical energy cheaper and for the general good of the whole German nation. The author proceeds to argue that if energy is to be rendered available at a low price, it will be necessary to build large generating stations right on the site of the coal resources and transmit the current by means of high pressure overhead conductors to distant transformer stations for distribution to consumers. But as the time of exhaustion of the coal resources will arrive, attention should also be directed to the question of the use of water-power, and this had best be done at the present time. Herr Plenske submits that the existing electricity works in the country should be allowed to remain as works in reserve, which would come into operation in the event of an interruption taking place in the working of the suggested pit-mouth or hydro-electric works, which he recommends.

Institution and Lecture Notes.—The Association of Engineers-in-Charge.—Many members of this Association recently paid a visit of inspection to the General Electric Co.'s Engineering and Carbon Works at Witton, and by the courtesies extended to them by Mr. H. Hirst (managing director) were able to inspect many processes connected with the company's manufactures and contrivances for which that firm is noted. The party travelled in special saloons to Birmingham, where they were met by the representatives of the Witton Works. Before proceeding to the works, luncheon was served at the Grand Hotel, and Mr. E. Wilson, who presided, welcomed the visitors. Mr. C. Wilson proposed "Success to the Association of Engineers-in-Charge," referring to his many years' connection with that body, and reviewing with great pleasure the very rapid strides the Association was making. It was now an Association of some considerable magnitude, and the muster which he saw before him demonstrated that fact very forcibly. Messrs. A. Davey and H. Capsey responded to the toast. The works were then visited, and upon returning to the Club premises a few further words of welcome were expressed by Mr. H. Hirst.

Junior Institution of Engineers.—At a recent meeting of this Institution, a paper entitled "Some Notes on Arc Lighting," by Mr. William Krause, was read and discussed. The author first compared the position of arc lighting of to-day with that of ten years ago, the special features of the open and enclosed types being pointed out. The development of the former was apparent from the increase in the number of lamps for public lighting; by the year 1907, out of 428 stations giving returns, 280 reported public arc lighting, with a total of 23,134 lamps. The open type was, however, now on the wane. With reference to the enclosed type, the author touched upon the various systems of control, and considered that for internal lighting that lamp would maintain its position for some time to come. The inverted arc system of reflection gave exce'lent illuminating results, but its cost was about 40 per cent. greater than that of direct lighting. The different effects produced in the colour of the light by the introduction of various salts and metals were described, and some notes on flame arc lighting were given. The paper concluded with a plea for the introduction of a two-colour light standard.

Birmingham and District Electric Club.—The third annual meeting was held on Thursday, 12th inst., when the following officers were elected for the forthcoming session.—

Committee.—Messrs. J. J. Inniss, E. R. Phillips, J. A. Jeckell, G. A. Pope, R. G. Mercer, R. Thompson and V. E. Walters.
President.—Mr. E. C. R. Marks, Assoc.M.Inst.C.E., M.I.Mech.E.
Vice-Presidents.—Mr. R. Coles, Mr. H. Roberts.
Treasurer.—Mr. E. A. Morgan. *Secretary.*—Mr. W. G. L. Riddle.
Assistant Secretary.—Mr. R. Thompson.

It has been decided again to hold the monthly meetings on Saturday evenings at 7 p.m.

Society of Engineers.—At the annual meeting held on December 9th, Mr. Joseph William Wilson was elected president for 1908. A Society's Premium of Books was awarded to Mr. C. A. St. George Moore for his paper on "Working Experiences with large Gas Engines."

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review posted as to their movements.

Central Station Officials.—The Beckenham U.D.C. has increased the salary of Mr. Tapper, resident engineer, by £75 per annum, as from July 1st last.

The Luton T.C. has increased the salary of Mr. H. A. Kell, chief assistant electrical engineer.

Mr. H. G. Young, for some time assistant manager and engineer at Musselburgh, under the National Electric Construction Co., has been promoted manager of the Bo'ness electricity works.

Australasian Hardware and Machinery publishes the following note:—"The electrical engineer to the Sydney (N.S.W.) City Council (Mr. T. Rooke) has tendered his resignation. It is said that aldermanic interference has endangered the discipline of the department and made the position intolerable."

Tramway Officials.—Mr. J. Bowden, who in 1904 was appointed as rolling stock superintendent in the L.C.C. Tramways Department, has resigned his position to take up another appointment. Mr. W. E. Ireland, the assistant rolling stock superintendent, is to be promoted to fill the position at a salary of £400 per annum.

Mr. J. Smith, late of the Burton and Ashby Light Railways, Swadlincote, has been appointed junior assistant engineer to the Swansea Improvements and Tramways Co., and takes up his duties immediately.

General.—On Monday at the London Chamber of Commerce several interesting presentations were made to some of those who took part in the Milan Exhibition British arrangements. Mr. Arthur Serena was presented with his portrait in oils, and a silver tea service and other testimonials were presented to Messrs. H. E. P. Cottrell and J. H. Cundall.

According to the *Times*, the Munich Academy of Science has elected Prof. Thomson, of Trinity College, Cambridge, as a corresponding member.

Messrs. Dorman & Smith, of Salford, have appointed Mr. S. Thomas Pemberton, A.I.E.E., Council Chambers, Colmore Row, Birmingham, to act as their agent in Birmingham and the surrounding district; and Mr. F. T. Hanks, A.M.I.E.E., 1, Higham Place, Newcastle-on-Tyne, as their agent in that town and the surrounding district.

Obituary.—The body of Mr. O. Burne, of the Indian Telegraph Service in Calcutta, who was staying at Torquay on leave, was found at the foot of a cliff at Babbacombe last week. It was thought that he had been sitting on the edge of the cliff, and when he attempted to rise had slipped and fallen headlong.

CITY NOTES.

Underground Electric Railways Co. of London, Ltd.

The directors in their report to June 30th, 1907, state that with the exception of a short length of line mentioned below, all the construction work undertaken by the company has been completed. Electrical power is now being furnished from the power house at Chelsea to the Metropolitan District, the Baker Street and Waterloo, the Great Northern, Piccadilly and Brompton, and the Charing Cross, Euston and Hampstead Railway Companies, as well as to a section of the London United Tramways. The average output of the power house is now about 100 million units per annum, and these are sold at a price which, whilst reasonable from the point of view of the railway companies, yields a satisfactory profit on the expenditure by the company on their power house undertaking.

Metropolitan District Railway Co.—The results for the past year have shown a slight improvement. The train services are now being increased and improved, and it is expected that next year's receipts will, in consequence, show a substantial increase.

Baker Street and Waterloo Railway Co.—In March last another section of this line was opened to the Great Central Station, Marylebone, and in June a further section to Edgware Road was opened for public traffic. It has been decided to postpone the construction of the further section from Edgware Road to the Great Western Station, Paddington, for the present. The results from the operation of this railway, which was the first to be opened of those constructed by the company, now show an increase of about 20 per cent. in the mileage receipts over last year, and the directors believe that the increase will continue.

Great Northern, Piccadilly and Brompton Railway Co.—As the line has become better known, the traffic receipts have increased month by month, and this increase will continue. On November 30th last, the last section of the line from Holborn to the Strand was opened to the public. This branch will serve as a feeder from the Strand district to the main line.

Charing Cross, Euston and Hampstead Railway Co.—The object of this railway, the receipts of which are now about £2,900 per week, was not only to serve the traffic moving along its route, but also to open out a new residential district at and beyond Golder's Green, which had no railway connection with London. Passengers can now travel from Golder's Green to Charing Cross in 21 minutes, and to the City, by changing at Euston or at Oxford Street, in 30 minutes. These facilities will, it is believed, lead to a rapid development of building in the Hampstead and Golder's Green neighbourhood. A growing traffic should also be obtained on the Highgate branch.

London United Tramways, Ltd.—All the construction work in connection with the Wimbledon extension has been completed, and this section has been in operation for some months past. The earnings of this company are increasing, though sufficient time has not yet elapsed for the Tramway Co. to derive the full benefit which must ultimately accrue from new construction and development.

General.—In April of this year the directors secured the services of Mr. Albert H. Stanley, who was up to that time general manager of the Public Service Corporation of the State of New Jersey, a railway company operating about 300 route miles of urban and suburban street railways in that State. He is now the general manager of this company, as well as of the District and the three Tube Companies above mentioned, by which means co-ordination and uniformity of operation are secured. The very unsettled state of the money markets of the world has seriously hampered the development and operations of the company, and this unrest still continues. Stocks all over the world have depreciated in price, and those dependent on London traffic have, owing to severe competition and excessive reduction in fares, fallen lower than many securities of intrinsically less value. The competitors for London passenger traffic include the London County Council, on whose growing network of tramways passengers are carried at fares which it is believed are in many cases unremunerative, and the motor-omnibus companies, who have come into the field since the incorporation of this company, but who probably cannot operate profitably on the basis of their existing fares. It seems at last, however, to have been universally recognised that for a large

number of companies to carry passengers at a loss is not sound business. The responsible heads of the principal London passenger traffic companies have therefore recently constituted a Traffic Conference, under the chairmanship of the company's managing director, Sir George S. Gibb, for the purpose of discussing the best means by which injurious competition can be, as far as possible, avoided. The board has been for some time considering, in conjunction with Messrs. Speyer, a plan for dealing with the £7,000,000 notes which will become due on June 1st, 1908. It is hoped that within a short time, probably early in 1908, the plan will be published and submitted to the shareholders and note-holders for their approval. In the meantime, Messrs. Speyer offered to purchase at their face value the coupons on the notes due December 1st, 1907.

The American Westinghouse Electric Co.

The receivers of the Westinghouse Electric and Manufacturing Co. have issued a balance-sheet as of October 23rd, which shows a surplus of $11,610,756. They announce that they have taken pains to figure the assets down to a basis as conservative as possible. Their valuation of the total assets of the company is $82,817,923. Compared with a statement issued last spring, this is an increase of $10,600,000 in the value of the assets as shown in the annual report. The receivers believe that the assets are worth $10,600,000 more now than in March last. A large portion of the increase is explained by the increase in the value of the investments. In March the investments, including stocks and bonds in subsidiary companies throughout the world, were valued at $22,296,806. The receivers' valuations of these assets are now $29,490,614, an increase of about $7,200,000 since the panic began. On March 31st, when the balance-sheet was struck, the company had a surplus of $12,595,151. According to the receivers' statement, the balance-sheet as of October 23rd shows a surplus of $11,610,756. The business of the company continues on a very large scale, with a maintained percentage of profit.

President George Westinghouse, of the company, has denied the published reports that the company's financial difficulties had been precipitated by big banking interests in New York. The appointment of the receivers, he stated, was an emergency measure taken on the advice of the Pittsburg Clearing House for the protection of all interests, the banks there being unable because of the financial stringency to co-operate with strong financial interests in New York, which had been prepared to extend the monetary aid needed.—*New York Electrical World.*

India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.

The meeting of this company was held on Tuesday at 106, Cannon Street, Major Leonard Darwin presiding.

The Chairman, in proposing the adoption of the report (see Electrical Review, December 13th, page 985), said he was pleased to be able to address them under conditions which, he believed, would give satisfaction to the shareholders. In the report it was stated that the price of raw material had fallen, and although prices were at present depressed it was difficult to form an opinion of any value as to the standard of prices to be adopted by manufacturers. They were all conversant with the results of overtrading which had been slowly developing themselves in America during the year just closing, and with the rumours of a somewhat similar condition in Germany. What effect this state of things would have on traders in this country it was, of course, impossible to predict, and their business could hardly be considered an exception to any rule which should apply to all others. One heard suggestions that the countries which were doubtless overstocked would try to liquidate these stocks by placing them on foreign markets at reduced prices. This might occur, but probably not to an alarming extent, because these stocks had been manufactured at the highest possible cost of raw material, and a liquidation at prices any lower than those now ruling would mean so enormous a loss as to shatter completely the remaining credit of the holders. Rather than this, it would be better for them to shut their works down, discharge the workpeople and hold the stocks until they could realise something approaching their value. If this should be the policy adopted, raw material would be sold at a much lower profit than had been the case during the last few years, whilst it would be the greatest folly on the part of manufacturers to reduce prices for several months to come, in face of this extremely uncertain market. It was common knowledge that one of the large manufacturing concerns in the rubber industry of the United States had recently discharged some 4,000 workpeople. Whether they had acted on the principle he had enunciated, or not, he could not say, but the alleged reason was that they had no currency at their command to pay the wages bills. He had given the foregoing digression from the immediate business they had to consider, as the board wished to lay before them an indication of the difficult situations which frequently presented themselves to manufacturers like themselves. While doing so, they wished to assure them that they faced the present condition of things without any fear so far as their interests were concerned, and to express the opinion that in all probability the balance of advantages and drawbacks would be in their favour during the present year. On several occasions the chairman at these meetings had referred to the high rates levied in the West Ham district, and to the bad effect these had on industrial enterprise. He was glad to state on this occasion that although these rates were still abnormally high, yet the work done on the Council of the borough by certain new councillors had created a more sane atmosphere during the deliberations of this body, with the result that the rates, which amounted formerly to the large figure of 10s. 10d. in the £, had now been reduced by praiseworthy economies to 9s. 9d. The general business of the company showed an increase when compared with last year, and he wished to draw special attention to the continued growth in public favour of the Palmer and Persan tires, of which they were the manufacturers. During the year they completed the equipment of an electric power and lighting station in the town of Dumfries. This undertaking, of no inconsiderable magnitude, would, as these undertakings did, take some time to develop; they anticipated, however, receiving from that outlay a small but increasing revenue. The electric power and lighting equipment of their Persan Works was also completed, and they hoped that this betterment would bear fruit in the near future. The New York-Havana cable which they manufactured and despatched for laying in their cable steamer *Silvertown* during the financial year ended December 30th last was successfully completed, although the cable had only been finally taken over since the closing of the company's accounts.

Lieut.-Col. A. Weston Jarvis, C.M.G., seconded the motion, and the report was adopted.

Prospectuses.—*Rangoon Electric Tramway and Supply Co., Ltd.*—The list was to close on Wednesday, 18th inst., in an issue of 10,000 6 per cent. £5 cumulative preference shares at par. These are to be applied, together with an issue of 25,000 £1 shares (subscribed and paid for in cash in Rangoon at £2 per share) in the extension of the company's undertaking.

County of Durham Electrical Power Distribution Co, Ltd.—Applications for an issue of £250,000 5 per cent. first mortgage debenture stock had also to be lodged by Wednesday. The issue was offered at par by the Newcastle-upon-Tyne Electric Supply Co., Ltd., who took them up at 95, the difference between purchase and issue price being represented as the cost of making the issue, and who unconditionally guarantee the interest. It will be utilised in paying existing liabilities amounting to about £90,500, representing moneys borrowed in connection with developments now in progress, and the remainder is required for extensions of distributing and other plant with which to meet the rapidly-growing demands for industrial power throughout the areas of the Power and Distribution Companies. All of the shares in the Power Co. are held by, or on behalf of, the Distribution Co.

Dumbarton Burgh and County Tramways Co, Ltd.—An issue of 75,000 6 per cent. preference shares of £1 each, and 64,000 ordinary of £1, has been offered for subscription this week.

Eastern Telegraph Co., Ltd.—A third quarterly interim dividend of 1¼ per cent. on the ordinary stock is payable January 15th.

Eastern Extension, Australasia and China Telegraph Co., Ltd.—An interim dividend for the quarter ended September 30th of 2s. 6d. per share, tax free, is declared.

Stratford-on-Avon Electricity Co., Ltd.—The directors' report to June 30th is to be submitted to the first ordinary general meeting at Stratford-on-Avon, on Monday next. It presents a revenue account for two months' trading, but it is stated that this does not form any criterion of the amount of business now being transacted.

Delhi Electric Tramways and Lighting Co., Ltd.—Colonel Sir Buchanan Scott, presiding at the meeting of this company on 12th inst., attributed the delays in carrying out the construction work by Messrs. Bruce Peebles & Co., to plague and labour deficiency. It was expected that the works would be completed and handed over to the company in January. There would be 10 miles of line. A small profit was being earned on the lighting work.

Stock Exchange Notice.—Applications have been made to the Committee to appoint a special settling day in and to grant a quotation to Canadian General Electric Co., Ltd.: Interim certificates (fully and partly paid) for $2,000,000 7 per cent. cumulative preference stock in shares of $100 each. And to allow the following securities to be quoted in the Official List: Shanghai Electric Construction Co., Ltd.—32,000 shares of £10 each, fully paid, Nos. 1 to 32,000.

Globe Telegraph and Trust Co., Ltd.—This company announces a quarterly dividend of 2s. per share.

Sao Paulo Tramways, Light and Power Co., Ltd.—The directors have declared a quarterly dividend of 2½ per cent. on the capital stock.

Costa Rica Electric Light Co., Ltd.—A meeting of this company was held at Dashwood House, Old Broad Street, on Wednesday. Our reporter was informed that the proceedings were private, and his request for a copy of the report and balance-sheet was refused.

British Westinghouse Electric and Mfg. Co., Ltd.—The holders of 4 per cent. mortgage debenture stock held a somewhat stormy meeting concerning the proposed placing of £300,000 prior lien debentures before their security (see p. 984, Electrical Review, December 13th). Our report of the proceedings will appear next week.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS.

Locality.	Fortnight ended.	Receipts for the fortnight. £	Receipts for the fortnight. £*	No. of wks.	Total to date. £	Total to date. £*	Route miles open.	Inc.
Aberdeen	Dec. 11	2,442	+ 16	28	40,456	— 1,490	14·4	..
Ayr	,, 14	860	+ 26	31	10,350	— 132	8	..
Bath	,, 11	1,186	— 72	50	39,149	+ 8,759	36	..
Belfast	,, 13	6,915	+ 301	37	136,118	+ 2	13·52	..
Birkenhead	,, 15	1,977	+ 46	36	39,658	..	56·46	..
Birmingham Corp.	,, 7	12,771	..	36	214,991	..	14·13	..
Blackburn	,, 11	1,989	+ 236	37½	41,980	+ 2,844	11·87	..
Blackpool Corp. ..	,, 12	610	+ 99	..	46,956	— 1,248	8·25	..
,, —Fleetw'd.	,, 14	98	+ 14	23	22,648	— 976	26	..
Bolton	,, 15	4,207	+ 383	37	84,690	+ 5,233	21·5	..
Bournemouth ..	,, 11	2,657	+ 258	36½	64,625	+ 1,343	54·9	1
Bradford	,, 7	8,513	+ 133	36	168,680	+ 3,262	9·5	..
Brighton	,, 15	1,363	— 9	37	34,916	— 3,026	28·5	..
Bristol	,, 13	9,109	+ 22	..	..	..	..	..
Brit. Elec. Trac. Co.					10,823	+ 40	3·65	..
Airdrie	,, 6	444	+ 8	48	8,122	+ 201	..	..
Barnsley	,, 6	316	+ 13	,,	12,462	— 217	5·37	..
Barrow	,, 6	497	+ 7	,,	4,076	— 230	..	..
Cavehill	,, 6	110	+ 8	,,	22,133	— 255	8·85	..
Devonport	,, 6	820	+ 2	,,	48,852	+ 1,276	11·25	..
Gateshead	,, 6	1,987	+ 38	,,	11,865	— 13	6·5	..
Gravesend	,, 6	412	+ 8	,,	31,588	— 556	7·25	..
Greenock	,, 6	1,004	— 89	,,	14,022	— 634	6·72	..
Hartlepool	,, 6	489	+ 1	,,	5,776	— 93	..	..
Kidderminster ..	,, 6	178	..	,,	7,888	— 589	3	..
Leamington	,, 6	249	+ 15	,,	10,244	+ 550	2·9	..
Merthyr	,, 6	416	+ 42	,,	226,176	+58,578	22	..
Metropolitan	,, 6	8,782	+2,371	,,	17,094	— 88	8·5	..
Middleton	,, 6	585	+ 9	,,	283,589	+ 4,445	..	..
Mid. Joint Com'tee	,, 6	11,337	+ 149	,,	29,263	+ 1,251	9·13	..
Oldham—Ashton ..	,, 6	1,057	— 47	,,	6,150	— 139	5·81	..
Peterborough ..	,, 6	208	+ 18	,,	91,799	+ 2,797	29	..
Potteries	,, 6	3 989	+ 209	,,	10,285	— 556	2·75	..
Rothesay	,, 6	81	+ 1	,,	14,393	— 698	8·17	..
Southport	,, 6	894	— 46	,,	38,603	..	..	..
S. Metropolitan ..	,, 6	1,338	..	,,	44,677	+ 3,133	6·5	..
Swansea	,, 6	1,745	+ 12	,,	11,681	— 799	3·75	..
Tynemouth	,, 4	274	— 30	,,	7,029	— 381	3	..
Weston-s-Mare ..	,, 6	53	— 6	,,	13,736	— 148	5·75	..
‡Worcester	,, 6	466	+ 11	,,	4,973	— 86	..	..
Wrexham	,, 6	180	— 12	,,	45,127	+ 777	17	..
Yorks. Wool. Dist.	,, 6	1,666	— 74	,,	10,814	— 186	..	..
Miscellaneous ..	,, 14	2,240	+ 196	..	..	..	7·1	..
Burnley	,, 15	511	— 18	37	10,685	— 518	11	1·5
Burton-on-Trent ..	,, 1	1,034	+ 121	..	..	..	10·5	..
‡Bury	,, 7	3,973	+ 210	36	78,384	— 2,299	15·87	..
Cardiff	,, 14	328	+ 22	50	8,725	— 521	..	..
Carlisle	,, 13	1,250	+ 38	50	25,756	+ 1,308	12·6	·68
Chatham and Dist.	,, 12	775	— 42	50	23,034	— 886	9·89	..
Cork	,, 13	2,567	+ 140	37	52,997	— 1,908	12	·75
Croydon	,, 7	200	+ 4	36	7,722	— 17	..	..
‡Darlington	,, 13	484	+ 19	37	9,505	— 15	4·36	..
Darwen	,, 7	335	— 26	36	8,526	— 1,122	4·75	..
Dover	,, 13	9,495	+ 216	..	157,414	+31,079	54·25	5·5
Dublin	,, 11	2,169	+ 100	30	24,559	+ 1,041	13·25	..
Dundee	,, 14	1,676	+ 151	37	33,891	+ 108	7·75	..
East Ham	,, 6	240	— 12	36	11,607	+ 561	4·75	·5
‡Exeter	,, 14	33,710	+1,479	27½	495,353	+14,276	39·75	5·5
Glasgow	,, 12	1,483	..	..	..	..	..	..
Hastings	,, 14	2,970	+ 198	37	59,468	+ 2,669	28	..
Huddersfield ..	,, 14	4,962	+ 409	37	91,316	+ 5,095	13	..
Hull	,, 11	249	+ 16	37	5,360	+ 310	8·5	..
Ilkeston	,, 7	357	+ 8	36	15,012	— 1,114	10·5	..
‡Ipswich	,, 14	456	+ 14	50	31,632	— 335	11	..
Isle of Thanet ..	,, 14	288	— 4	30	4,876	— 110	4·25	..
Kilmarnock	,, 12	2,418	+ 745	50	60,200	+15,994	15·82	8·26
Lan'kshire Trm Co.	,, 11	1,199	+ 217	50	63,105	+14,082	39	1
Lancashire United	,, 7	12,302	+ 269	36	237,018	+ 9,633	51·12	..
Leeds	,, 14	4,172	+ 117	..	..	..	..	..
Leicester	,, 7	998	— 1	29½	15,764	+ 27	6	..
Leith	,, 7	30,693	— 488	49	534,911	+ 7,583	104	..
Liverpool	,, 7	60,003	+8,375	35	1,131,236	+187,352	116·5	10
‡L.C.C.	,, 13	10,655	+ 527	..	321,845	+13,712	..	..
London United ..	,, 14	210	+ 26	11	1,917	+ 4	3·5	..
Lowestoft	,, 14	28,315	+2,038	37	550,890	+37,782	86	11
Manchester	,, 14	7,918	+ 69	37	152,083	+ 589	..	..
Newcastle	,, 7	1,218	+ 49	36	25,074	+ 1,980	14·5	..
Newport	,, 13	777	+ 43	36½	16,165	— 413	5·5	..
Northampton ..	,, 15	3 650	+ 336	38	74,086	+ 4,825	33·75	..
Oldham	,, 14	533	+ 228	37	9,985	+ 3,781	5	1·75
Pontypridd	,, 14	2,996	+ 97	37	75,124	— 1,500	14·5	..
Portsmouth	,, 11	1,363	+ 19	..	..	..	..	..
Preston	,, 5	567	+ 9	35½	22,429	— 788	13·25	..
†Reading	,, 13	1,150	+ 181	36½	32,367	+ 3,647	10	·66
Rotherham	,, 9	9,583	+ 86	36	169,401	+ 4,491	38·9	..
Salford	,, 8	10,935	+ 272	37	205,492	+ 9,405	35·75	..
Sheffield	,, 11	1,888	+ 230	36	38,320	+ 1,971	..	..
Southampton ..	,, 11	526	+ 36	37	15,736	— 17	..	..
Southend-on-Sea ..	,, 15	2,390	— 129	37	51,612	— 1,119	..	..
Sunderland	,, 11	224	+ 2	..	..	..	4·4	..
Swindon	,, 11	752	— 1	50	22,898	+ 919	8·87	..
Tynemouth	,, 14	1,491	— 16	37	31,583	+ 689	8·72	·22
Wallasey	Nov. 30	958	+ 106	35	21,979	+ 481	9	..
Walthamstow ..	Dec. 12	4,353	+ 192	37	85,924	+ 1,656	14·7	..
West Ham	,, 11	1,574	— 19	36	34,407	+ 213	12·5	..
Wolverhampton ..	,, 8	1 084	+ 87	49	56,924	..	..	1
†Yorks. W. Riding	,, 14	5,920	+1,076	24	60,045	+20,830	4·25	..
Baker St.-Waterloo	,, 14	12,179	—1,606	24	138.547	—19,279	6	..
Cen. London Rly...	,, 14	5.850	..	24	63,625	..	7·75	1·05
Char. +, Eus. Hamp.	,, 14	6,878	+ 565	24	75 388	+10,308	7 3	..
City & S. Lon. Rly.	,, 15	176	— 10	24	3,199	+ 216	7	..
Dublin-Lucan Rly.	,, 13	3,953	— 130	24	40,515	— 917	3·5	..
G.N. and City Rly.	,, 14	10.225	..	24	103,020	..	9	..
G.N., P'dy. & Brmp.	,, 14	2,685	+ 26	24	87,144	+ 1,743	8·8	4·8
L'pool Overh'd Rly.	,, 15	3.762	+ 194	24	44 328	+ 3,037	4·5	..
Mersey Railway ..	,, 14	32,287	+ 876	24	363,108	+ 6,504	24·5	..
Metropolitan Rly...	,, 15	17,258	+ 665	24	196,841	+ 636	24	..
Met. District Rly...	,, 14	38,612	+3,418	50	845,499	+79,605	48	..
Anglo-Argentine ..	,, 16	10,674	+ 946	44½	114,568	+ 5,001	19·2	·66
§Auckland	Nov. 8	13,570	+1,784	17½	130,633	+37,121	6·8	4·8
§Brisbane	Nov.	36,499	+10,964	49	189,749	+10,212	..	..
§Brit. Columbia Rly.	October	9,267	+ 157	..	..	..	..	..
Buenos A. & Belgr'o.	Dec. 9	6,451	— 410	..	..	..	..	..
Calcutta	,, 14	9,240	..	..	..	..	..	..
§Cape Electric T. Ltd.	August	7,533	+ 321	..	..	..	20·5	..
§Geneva	Nov.	3,963	..	48	39,925	+ 4,386	12·75	·5
§Kalgoorlie, W.A...	October	1,223	+ 223	50	26,431	..	..	..
Madras	Dec. 15	7,970	..	..	..	— 2,676	25·6	·4
§Lisbon	October	2,822	— 645	50	70,054	..	..	..
Perth (W.A.) ..	Dec. 13							

* Compared with the corresponding period of 1906. † One week only.
‡ Includes horse, steam and other receipts. § One month.

STOCKS AND SHARES.

Tuesday Evening.

The improvement noticed in our report last week has been well maintained, and, in a good many cases, pursued still further. Several new issues braved the inclemency of the financial elements, and business in stocks and shares shows a slight tendency to expand. Coming so close to the end of the year, the last-named factor is fairly taken as encouraging.

Interest in the railway world centres chiefly upon the details, now published, of the working agreement between the Great Northern and Great Central. For a year or two the chief advantages will be those derived by more economical working, and the union of rails will perhaps set free the Great Northern for the tackling of those electrical-suburban problems which have been discussed for some time past.

Central London Deferred is a trifle harder, upon the decision of the omnibus companies to shorten the distances prevailing for their present scale of fares. City and South London at 44 is almost on a line with Central London Deferred, the latter standing the lower of the two.

Metropolitan Consols eased off to 36½, and the dividend prospects for the current half-year are regarded as gloomy. Districts keep about 8½. The report of the Underground Electric Railways of London is of the usual type; it does not give certain details, such, for example, as the cost price of all the investments, which would be of great service to those concerned. The document speaks of a new scheme in regard to the profit-sharing notes, and particulars are to be announced shortly.

The County of Durham new Debenture stock looks well secured and cheap. There is not much probability of its obtaining a free market in London; no doubt the dealing will be mainly in Newcastle. It may be pointed out that the company's Ordinary shares stand at 3⅞ and the Preference at 4⅝, both being of the nominal value of £5 fully paid.

Rangoon Electric Preference, another new issue, will probably be marketed mostly in Liverpool. A third offer is by the Dumbarton Burgh Tramways Company, where Ordinary and Preference can be applied for.

Electricity Supply shares, still a quiet market, show improvement in Metropolitan Ordinary, St. James' Preference, South London Ordinary and both class of Westminster shares. The forced realising of Westminsters has ceased, and the market find there are several buyers about. Edmundson's Preference and Brush Preference are lower.

One day last week the new part of Victoria Station, now in course of construction, had the narrowest escape possible from a disastrous fire. Short-circuit again!

Electric Constructions still advance, and are quoted at 7s. 6d. Other manufacturing shares keep firm, marking few alterations in price.

British Westinghouse Debenture was sold at 45½ and 46 on Monday, and the nominal prices show a drop of 5 points, although actually the fall is greater than this. It is due to sales on behalf of those who strongly object to the new Prior Lien issues. The Preference shares are lower at a fraction under a pound. British Electric Traction Ordinary lost all their rise, and more, of last week, but the Preference advanced 5s. To perfect the anomaly, the First Debenture stock shed a point.

Other Traction securities are mostly good. Anglo-Argentines maintained their strength, and 5s. more has been added to the Second Preference. It is very difficult to buy the shares at 8. British Columbia Electric Railway stocks are strong, and Auckland First Debenture has hardened.

Sunderland District Electric 5 per cent. Debentures are 4 lower at 82. A rise of twice as much occurred in the Ordinary stock of the Sao Paulo Light and Power Company, upon the announcement of a quarterly dividend of 2½ per cent. The price now stands at 119, and the dividend is payable next New Year's day.

Telegraph issues are somewhat irregular, though not one of the fluctuations is possessed of importance. Marconi's Ordinary shares fell 2s. 6d. to 12s. 6d. Globe Telegraph and Trust are *ex* dividend as regards both kinds of shares. Mackay Companies Common stock was marked down 2½, *ex* 1 per cent. dividend, and the Preference rose 5, plus another 1 for the dividend, but these are rather fancy figures, the market being extremely narrowed.

The Telephone Co. of Egypt, Ltd.—The Register of Transfers of 4 per cent. and 4½ per cent. redeemable debenture stock will be closed from December 16th to 31st, both days inclusive, for the preparation of warrants for the half-yearly interest.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. *	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Dec. 10th.	Closing Quotations Dec. 17th.	Business done week ended Dec. 17th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	Nil	Nil	Nil	..	2½ — 3½	2½ — 3½	..	..	..	Nil
149,600	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	Nil	Nil	5 %	5 %	85 — 88	85 — 88	..	..	..	5 13 8
$131,551,400	American Telephone & Telegraph, Cap. Stock	$100	7½%	7½%	7½%	8 %	106 —109	105 —108	..	..	— 1	7 8 2
$53,000,000	Do. Collat. Trust, 4% Bonds, 1 to 28,000 and 53,001 to 78,000	$1000	4 %	4 %	4 %	4 %	88 – 90	88 — 90	..	..	..	4 8 11
660,660	Anglo-American Telegraph	Stock	61s.	23%	31%	31%	55 — 58	55 — 58	..	..	..	6 13 7
3,169,670	Do. do. do. 6 % Pref.	Stock	6 %	5½%	6 %	6 %	99 — 101	99 —101	100½	99	..	5 18 10
3,169,670	Do. do. do. Deferred	Stock	2s.	Nil	⅛%	12½%	14⅜ — 15½	15 — 15½	15⅝	15⅛	+ ⅛	11 5 10
50,000	Anglo-Portuguese Tel., 5 % Mort. Deb. Stock Red.	100	..	..	5 %	5 %	99 —102	99 —102	..	..	..	4 18 0
44,000	Chili Telephone, Nos. 1 to 44,000	5	7 %	8 %	8 %	8 %	6⅞ — 7⅛	6⅞ — 7⅛	..	..	..	5 10 4
2,097,680	Commercial Cable Stlng. 500 year 4 % Deb. Stk. Red.	Stock	4 %	4 %	4 %	4 %	82 — 86	82 — 86	..	..	..	4 13 0
16,000	Cuba Telegraph	10	0 %	5 %	5 %	5 %	6 — 7	6 — 7	..	..	..	7 2 10
6,000	Do. 10 % Pref.	10	15 %	10 %	10 %	10 %	15 — 16	15 — 16	..	..	..	6 5 0
12,981	Direct Spanish Telegraph, Ord.	5	4 %	4 %	4 %	4 %	3⅛ — 3⅜	3⅛ — 3⅜	..	..	..	5 14 3
6,000	Do. do. 10 % Cum. Pref. ..	5	10 %	10 %	10 %	10 %	8⅛ — 8½	8⅛ — 8½	..	..	..	5 14 3
30,000	Do. do. 4½ % Debs.	50	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	8 18 2
60,710	Direct United States Cable	20	3 %	3½%	4½%	4½%	13⅜ — 13⅞	13⅛ — 13⅜	..	..	— ⅛	6 12 7
57,000	Direct W. India Cable, 4½ % Reg. Deb., 1 to 1,200, R.	100	4½%	4½%	4½%	4½%	100 —102	100 —102	..	..	..	4 8 3
4,000,000	Eastern Telegraph, Ord. Stock..	Stock	7 %	7 %	7 %	7 %	128 —133	129 —134	133	131	+1	5 4 6
2,000,000	Do. 3½ % Pref. Stock..	100	3½%	3½%	3½%	3½%	83 — 86	83 — 86	84⅜	83	..	4 1 5
1,896,706	Do. 4 % Mort. Deb. Stock. Red. ..	Stock	4 %	4 %	4 %	4 %	98½ —101¼	99 —102	100⅜	99⅜	+ ⅜	3 18 5
300,000	Eastern Extension, Australasia, and China Tele.	10	7 %	7 %	7 %	7 %	12⅜ — 12⅞	12⅜ — 12⅞	12¼	..	..	5 8 9
752,400	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	99 —102	99¼ —102½	101	100½	+ ½	3 18 1
295,400	East & S. Afric. Tel., 4 % Mt. Db., 1 to 8,000, red. 1909	100	4 %	4 %	4 %	4 %	98 —101	98 —101	..	..	..	3 19 3
200,000	Do. 4 % Reg. M. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	4 %	98¼ —100½	98¼ —100½	..	..	..	3 19 7
181,127	Globe Telegraph and Trust	10	5½%	5⅜%	5½%	5½%	9⅞ — 10⅛	9⅞ — 10⅛	10⅜	9⅞	..	5 6 0
181,127	Do. do. 6 % Pref...	10	6 %	6 %	6 %	6 %	13 — 13½	12¾ — 13⅛	13¼	12¾	— ⅛	4 10 7
150,000	Great Northern Telegraph, of Copenhagen.. ..	10	15 %	24 %	24%	20 %	30½ — 32½	30⅜ — 32½	30⅝	30½	..	6 3 1
28,900	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	4½%	4½%	4½%	4½%	99 —101	99 —101	..	..	..	4 9 1
17,000	Indo-European Telegraph	25	10 %	13 %	13 %	13 %	52 — 55	52 — 55	52½	..	..	6 5 0
$41,380,400	Mackay Companies Common	$100	..	1 %	2 %	3½%	50 — 60	50 — 55 xd	..	..	—2½	6 7 3
$50,000,000	Do. do. 4% Cum. Pref.	$100	..	4 %	4 %	4 %	50 — 60	55 — 65 xd	..	..	+ 5	6 3 1
256,127	Marconi's Wireless Telegraph	1	Nil	Nil	Nil	..	1/16 — 1/8	3/32 — 3/16	14/-	..	— 1/32	Nil
72,680	Monte Video Telephone Co., Ltd. Ord.	1	3 %	4 %	5 %	6 %	1/32 — 1/16	1/32 — 1/16	..	..	..	4 14 1
86,492	Do. do. do. 5 % Pref. ..	1	5 %	5 %	5 %	5 %	3/4 — 1	3/4 — 1	..	..	..	5 0 0
2,225,000	National Telephone, Pref. Stock	100	6 %	6 %	6 %	6 %	107½ —109½	108 —110	109⅞	107½	+ ½	5 9 1
2,225,000	Do. do. Def. Stock	100	5 %	5 %	5 %	5 %	106 —108	106 —108	107½	106½	..	4 12 7
15,000	Do. do. 6 % Cum. 1st. Pref.	10	6 %	6 %	6 %	6 %	10¾ — 12¾	10¾ — 12¾	..	..	..	4 16 0
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	5 %	10 — 12	10 — 12	..	..	..	4 3 4
250,000	Do. do. 5 % Non-cum. 3rd P., 1 to 250,000	5	5 %	5 %	5 %	5 %	5⅞ — 5⅞	5⅞ — 5⅞	..	..	..	4 11 11
2,000,000	Do. do. 3½ % Deb. Stock Red. ..	Stock	3½%	3½%	3½%	3½%	97 — 99	97 — 99	..	..	..	3 10 8
1,689,598	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	100 —102	100 —102	101	100½	..	3 18 5
179,313	Oriental Telep. and Elec. 1 to 171,504, fully paid ..	1	6¾%	6¾%	7 %	7 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 17 11
50,000	Do. do. do. 6 % Cum. Pref... ..	1	6 %	6 %	6 %	6 %	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	5 1 1
100,000	Do. do. do. 4 % Red. Deb. Stock ..	100	..	..	4 %	4 %	90 — 93	90 — 93	..	..	..	4 6 0
100,000	Pacific & European Tel., 4 % Guar. Debs., 1 to 1,000	10	4 %	4 %	4 %	4 %	97 —100	97 —100	..	..	..	4 0 0
11,839	Reuter's	8	5 %	5 %	5 %	5 %	7 — 8	7 — 8	..	..	..	5 0 0
60,000	Telephone Co. of Egypt, 4½ % Deb. Red.	100	..	..	4½%	4½%	99 —102	99 —102	101	..	..	4 8 3
3,167	Submarine Cables Trust	Cert.	6 %	6 %	6 %	6 %	124 —127	124 —127	..	..	..	4 14 6
80,000	United River Plate Telephone	5	8 %	8 %	8 %	8 %	6⅝ — 7⅛	6⅝ — 7⅛	6⅝	..	..	5 12 3
40,000	Do. 5 % Cum. Pref., Nos. 1 to 40,000	5	5 %	5 %	5 %	5 %	4⅞ — 5⅛	4⅞ — 5⅛	..	..	..	4 13 0
15,609	West African Telegraph, Shares	10	4 %	4½%	4 %	4 %	10 — 10½	10 — 10½	..	..	..	3 16 9
30,008	W. Coast of America, 1 to 30,000 & 53,001 to 53,008	2	Nil	Nil	Nil	2½%	1⅛ — 1⅜	1⅛ — 1⅜	..	..	..	3 12 9
150,000	Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4 %	4 %	4 %	4 %	97 —100	97 —100	22/6	..	..	4 0 0
207,330	Western Telegraph, Ltd., Nos. 1 to 207,930.. ..	10	7 %	7 %	7 %	7 %	12⅞ — 13⅛	12⅞ — 13⅛	13	12⅝	— ⅛	5 6 8
800,000	Do. do. 4 % Deb. Stock Red. ..	100	4 %	4 %	4 %	4 %	99¼ —101½	98¾ —101⅛	100	..	..	3 18 10
88,321	West India and Panama Telegraph	10	Nil	Nil	Nil	Nil	3/32 — 7/32	3/32 — 7/32	8/1½	..	— 1/32	Nil
34,563	Do. do. 6 % Cum. 1st Pref.	10	7 %†	6 %	5 %	8 %	7 — 7⅛	7 — 7⅛	7	6⅞	..	10 13 4
4,669	Do. do. 6 % Cum. 2nd Pref.	10	Nil	Nil	Nil	Nil	7 — 7⅛	6⅞ — 7⅛	..	..	..	Nil
80,000	Do. do. 5 % Debs., Nos. 1 to 1,800 ..	100	5 %	5 %	5 %	5 %	99 —102	99 —102	100	..	..	4 18 0

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

270,000	Anglo-Argentine Trams, 10 % Nom. Cum. 2nd Pref., 260,008 to 530,007	5	..	8 %	8 %	8 %	7½ — 8	7⅞ — 8⅛	8	7⅞	+ ⅛	4 17 0
260,007	Do. 6 % Cum. Prefs., 1 to 260,007 ..	5	5½%	5⅜%	5½%	5½%	5⅛ — 5⅜	5⅛ — 6 1/16	5⅜	..	..	4 10 9
266,600	Do. Permanent, 6 % Deb. Stock, 1888	100	6 %	6 %	6 %	6 %	128 —131	128 —131	..	..	..	4 11 7
285,100	Auckland E. Trams, 5 % 1st Mort. Deb. Stock ..	100	5 %	5 %	5 %	5 %	102 —105	103 —106	..	..	+1	4 14 4
330,000	Babcock & Wilcox, 1 to 330,000	1	17 %	20 %	20 %	20 %	3⅛ — 3⅜	3⅛ — 3⅜	71/8	..	..	5 6 8
100,000	Do. do. 6 % Cum. Pref., 1 to 100,000 ..	1	6 %	6 %	6 %	6 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	3 16 10
38,000	British Aluminium, Ord., 2,001 to 40,000	5	..	7 %	7 %	7 %	4⅛ — 4½	4⅛ — 4½	..	..	— ½	8 4 8
40,000	Do. do. 7 % Cum. Pref.	5	Nil	7 %	7 %	7 %	4⅜ — 5	4⅜ — 5	..	..	..	7 0 0
20,000	Do. do. "A" 6 % Cum. Pref.	5	Nil	6 %	6 %	6 %	4⅜ — 4⅝	4⅜ — 4⅝	..	..	..	6 6 4
20,000	Do. do. 4 % Funding Certs.	5	..	4 %	4 %	4 %	3¾ — 4⅛	3¾ — 4⅛	80/-	..	..	4 14 1
258,000	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	5 %	5 %	5 %	5 %	100 —103	100 —103	..	..	..	5 13 5
300,000	Do. do. 5½ % Loch Leven Debs. ..	100	..	..	..	5½%	94 — 97	95 — 98	..	..	+1	5 12 3
400,000	British Columbia E. Rail Def. Ord. Stock	100	6 %	6 %	6 %	6 %	123 —128	124 —127	..	..	..	4 10 3
300,000	Do. 5 % Pref. Ord. Stock	100	5 %	5 %	5 %	5 %	104 —109	107 —111	125½	124¾	+2½	4 10 1
300,000	Do. 5 % Cum. Perp. Pref. Stock	100	5 %	5 %	5 %	5 %	99 —103	99 —103	110½	107½	..	4 17 1
238,000	Do. 4½ % 1st Mort. Debs., 1 to 6,250	40	4½%	4½%	4½%	4½%	98 —101	98 —101	..	..	..	4 9 1
220,000	Do. 4½ % Vancouver Power Debs., 1 to 2,200	100	4½%	4½%	4½%	4½%	100 —103	100 —103	99¾	..	..	4 7 5
133,301	British Electric Traction	10	6 %	6 %	3 %	Nil	1⅜ — 2⅛	1½ — 1⅝	35/-	28/9	— ⅜	Nil
161,437	Do. do. 6 % Cum. Pref.	10	6 %	6 %	6 %	6 %	4⅜ — 5¼	5 — 5½	5 7/16	5 1/16	+ ⅛	10 18 2
1,448,653	Do. do. 5 % Perp. Deb. Stock ..	Stock	5 %	5 %	5 %	5 %	91 — 94	90 — 93	91⅛	91	—1	5 7 6
410,178	Do. do. 4½ % 2nd Deb. Stock Red.	100	..	4½%	4½%	4½%	70 — 75	70 — 75	..	..	..	6 0 0
100,000	British Insulated and Helsby Cables	5	8 %	8 %	8 %	10 %	6¼ — 7	6⅛ — 7	..	..	..	7 2 10
100,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	6 %	5⅝ — 6⅛	5⅝ — 6⅛	..	..	..	4 18 0
500,000	Do. do. 4½ % 1st Mort. Deb. Red. ..	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6 7
212,000	British Thomson-Houston 4½ % 1st Mort. Debs. ..	100	4½%	4½%	4½%	4½%	85 — 89	85 — 89	..	..	..	4 18 11
400,000	British Westinghouse 6 % Pref., 1 to 200,000 and 275,001 to 475,000	5	6 %	Nil	Nil	Nil	¾ — 1⅛	¾ — 1⅛	18/1½	..	— ⅛	Nil
1,016,353	Do. do. 4 % Mort. Deb. Stock ..	100	4 %	4 %	4 %	4 %	55 — 65	45 — 55	46	45½	—10	7 5 6
50,000	‡ Browett, Lindley & Co., Ord.	£1	Nil	Nil	Nil	..	3/16 — 11/16	3/16 — 11/16	..	..	..	Nil
50,000	‡ Do. do. 6 % Cum. Pref.	£1	Nil	Nil	Nil	..	14/6 to 15/6	14/6 to 15/6	..	..	..	Nil
105,731	Brush Electrical Engineering, Ord., 1 to 105,731 ..	2	Nil	Nil	2½%	Nil	0— 3/16	0 — 3/16	..	..	..	Nil
150,000	Do. do. Non-cum. 6 % Pref.	2	6 %	6 %	6 %	Nil	3/16 — 5/16	3/16 — 5/16	..	..	— 1/16	Nil
125,000	Do. do. 4½ % Perp. Deb. Stock ..	Stock	4½%	4½%	4½%	4½%	83 — 86	83 — 86	..	..	..	6 12 4
125,000	Do. do. 4½ % Perp. 2nd Deb. Stock..	Stock	4½%	4½%	4½%	4½%	65 — 68	65 — 68	..	..	..	6 8 7
100,000	Buenos Ayres & Belgrano, 1 to 100,000	5	3 %	4 %	3 %	3 %	4⅛ — 4½	4⅛ — 4½	..	..	..	3 4 10
40,000	Do. do. "A" 6 % Cum. Pref., 1 to 40,000	5	6 %	6 %	6 %	6 %	4½ — 5¼	4½ — 5¼	90/3	..	..	5 14 9
27,500	Do. do. "B" do., 1 to 27,500	5	6 %	6 %	6 %	6 %	4¼ — 5¼	4¼ — 5¼	..	..	..	5 14 9
13,200	Do. do. 5 % Deb. Stock	100	5 %	5 %	5 %	5 %	105 —115	105 —115	..	..	..	4 6 11
190,000	Do. do. 5 % 2nd Deb. Stock	100	5 %	5 %	5 %	5 %	102 —105	102 —105	..	..	..	4 15 3
197,610	Calcutta Trams, 1 to 197,610	5	6 %	8 %	8 %	8 %	6⅜ — 6⅞	6⅜ — 6⅞	6⅜	..	..	5 16 4
30,000	Do. 5 % Cum. Pref., Nos. 1 to 29,830..	5	..	..	5 %	5 %	5 — 5½	5 — 5½	..	..	..	4 5 6
350,000	Do. 4½ % 1st Deb. Stock..	100	4½%	4½%	4½%	4½%	101 —105	101 —105	..	..	..	4 6 7
35,000	Callender's Cable Construction shares	5	12½%	12½%	15 %	15 %	9⅜ — 10⅛	9⅜ — 10⅛	9⅜	..	..	7 6 4
40,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	5⅝ — 6⅜	5⅝ — 5⅞ xd	..	..	— ⅛	4 6 11
300,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	105½ —107½	105½ —107½	105½	..	..	4 2 4
491,222	Cape E Trams., 1 to 491,222	1	10 %	5 %	Nil	Nil	3/16 — 5/16	3/16 — 5/16	..	..	..	Nil
450,000	Castner-Kellner Alkali, 1 to 450,000	1	4 %	4 %	6 %	8 %	1 1/16 — 1 1/8	1 3/32 — 1 1/32 xd	27/-	26/3	— 1/32	5 18 6
224,988	Do. do. 4½ % 1st Mort. Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	103	102½	..	4 6 7
911,568	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	4 %	62 — 65	62 — 65	64	63¼	..	6 3 1
544,216	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	4 %	83 — 85	83 — 85	..	..	..	4 14 2
544,216	Do. do. Def. do.	Stock	4 %	4 %	4 %	4 %	41 — 43	41 — 44	..	..	..	9 0 0
1,480,000	City and South London Railway	Stock	2¾%	2¾%	1⅞%	2¼%	43 — 45	43 — 45	44⅜	44	..	4 14 5

* Unless otherwise stated, all shares are fully paid. † A period of nine months. ‡ From Manchester Share List.

(Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.—(*Continued*)

Present Issue.	NAME.	Stock or Share.	Dividends for the last four years. 1903.	1904.	1905.	1906.	Closing Quotations Dec. 10th.	Closing Quotations Dec. 17th.	Business done week ended Dec. 17th, 1907. Highest	Lowest.	Rise + or Fall —	Present Yield per cent. £ s. d.
85,000	Crompton & Co., Nos. 1 to 85,000	£	2½%	2½%	2½%	5 %	1 15/16 — 1 13/16	1 15/16 — 1 13/16	..	..	..	8 6 8
100,000£	Do. 5 % 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	..	5 %	5 %	5 %	5 %	96 — 99	96 — 99	..	..	..	5 1
260,000	Dick, Kerr & Co., 1 to 260,000	1	..	10 %	10 %	10 %	1 3/8 — 1 1/2	1 3/8 — 1 1/2	..	..	..	7 5
305,000	Do. do. 6 % Cum. Pref., 1 to 305,000	1	6 %	6 %	6 %	6 %	1 — 1 1/8	1 — 1 1/8	..	..	..	4 16
294,150	Do. do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	101 —104	101 —104	..	..	..	4 6
60,000	Dublin United Trams. (1896), 1 to 60,000	10	5½%	6 %	6%	6 %	12½ — 13½	12½ — 13½	..	..	..	4 8 11
59,987	Do. 6 % Pref. between 1 and 60,000	10	6 %	6 %	6 %	6 %	12½ — 13½	12½ — 13½	..	..	..	4 7 8
99,261	Edison & Swan Utd., "A" shs., £3 pd., 1 to 99,261	5	Nil	2½%	4½%	4½%	1/8 — 1/4	1/8 — 1/4	..	..	..	11 7 6
17,139	Do. "A" shares, 01—017,139	5	Nil	2½%	4½%	4½%	1½ — 2½	1½ — 2½	..	..	..	8 6 9
319,475	Do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	79 — 82	79 — 82	..	..	..	4 17 7
72,220	Do. 5 % 2nd Deb. Stock Prov. Certs. all pd.	100	5 %	5 %	5 %	5 %	87 — 90	87 — 90	..	..	..	5 11 1
112,100	Electric Contruction, 1 to 112,100	2	4 %	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	6/9	..	+ 1/16	Nil
31,390	Do. do. 7 % Cum. Pref., 1 to 31,390	2	7 %	7 %	7 %	Nil	1/8 — 1/4	1/8 — 1/4	17/6	..	..	Nil
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	4 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
200,000	Do. do 4 % Mort Deb.	Stock	4 %	4 %	4 %	4 %	89 — 92	89 — 92	..	..	..	4 19 11
78,000	Gt. N. & City Rail. Pref. Ord. "A" 4 %, 1 to 78,000	10	3 %	4 %	4 %	4 %	1¼ — 1½	1¼ — 1½	..	..	..	15 4 10
96,000	Greenwood & Batley, 7 % Cum. Pref.	10	7 %	7 %	7 %	7 %	10¼ — 10½	10¼ — 10½	..	..	..	6 10 8
80,000	Do. do. 5 % Mort. Debs.	100	5 %	5 %	5 %	5 %	102 —103	102 —103	..	..	..	4 17 1
200,000	Henley's (W. T.), Telegraph Works, Ord.	5	15 %	15 %	15%	15 %	10½ — 11¼	10½ — 11¼	..	..	..	6 10 0
200,000	Do. do. 4½ % Pref.	5	4½%	4½%	4½%	4½%	5 — 5½	5 — 5½	5	..	..	3 17 8
150,000	Do. do. 4½ % Mort. Deb. Stock	Stock	4½%	4½%	4½%	4½%	104 —106	104 —106	..	..	..	4 3 9
50,000	India-Rubber, Gutta-percha & Telegraph Works.	10	10%	5 %	10%	10 %	14½ — 15½	15½ — 16½	..	..	+ ½	6 3 1
37,500	†Liverpool Overhead Railway, Ord.	10	1¾%	1½%	Nil	Nil	1½ — 1¾	1½ — 1½	..	..	..	Nil
10,000	† Do. do. Pref., fully paid	10	5 %	5 %	5 %	5 %	8 — 8½	8 — 8½	..	..	..	5 17 8
600,070	London United Trams. (1901), 1 to 50,007	10	8 %	6 %	3 %	3 %	6½ — 6¾	6½ — 6¾	..	..	..	4 8 11
399,930	Do. do. 60,008 to 100,000	10	8 %	6 %	3 %	3 %	6½ — 6¾	6½ — 6¾	..	..	..	4 8 11
125,000	Do. do. 5 % Cum. Pref., 1 to 125,000	10	5 %	5 %	5 %	5 %	7½ — 8¼	7½ — 8¼	..	..	..	6 1 3
1,381,000	Do. do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	82 — 86	82 — 86	82½	82	..	4 13 0
314,016	Metropolitan Electric Trams., Defd.	1	Nil	Nil	Nil	Nil	1/16 — 1/8	1/16 — 1/8	..	..	..	Nil
500,000	Do. do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	13/16 — 15/16	13/16 — 15/16	..	..	..	5 6 8
350,000	Do. do. 4½ % Deb. Stock Red.	100	..	4½%	4½%	4½%	93 — 96	93 — 96	93½	..	..	4 13 9
245,500	Potteries E. Trc.	1	5 %	5 %	4 %	4 %	1/16 — 1/8	1/16 — 1/8	..	..	..	7 2 3
245,500	Do. 5 % Cum. Pref.	1	5 %	5 %	5 %	5 %	1/8 — 1/4	1/8 — 1/4	..	..	..	6 13 4
245,000	Do. 4½ % Deb. Stock	100	4½%	4½%	4½%	4½%	93 — 96	93 — 96	..	..	..	4 13 9
37,350	Telegraph Construction and Maintenance	12	20 %	15 %	15 %	15 %	28½ — 30½	28½ — 30½	29¾	28½	..	5 7 2
150,000£	Do. 4 % Ded. Bds., 1 to 1,500 Red., 1909	100	4 %	4 %	4 %	4 %	100 —103	100 —103	..	..	..	3 17 8
599,200	Undergd. E. R., Lon., 5 % Profit Shar. S. Nts.	..	..	5 %	5 %	5 %	35 — 39	35 — 39	..	..	..	13 3 2
66,666	Willans & Robinson, 1 to 30,000 & 80,001 to 116,666	5	3 %	Nil	Nil	..	1/8 — 1/4	1/8 — 1/4	..	..	..	Nil
66,666	Do. 6 % C.P., 30,001 to 80,000 & 125,001 to 141,666	5	6 %	Nil	Nil	..	3 1/4 — 3 3/4	3 1/4 — 3 3/4	..	..	..	Nil
246,574	Do. 4 % 1st Mort. Deb. Stock	100	4 %	4 %	4 %	4 %	72 — 77	72 — 77	72	..	..	5 1 3

ELECTRICITY SUPPLY COMPANIES.

14,000	Bromley (Kent) E.L. & P,. 1 to 14,000	5	5 %	5½%	5½%	5½%	4 5/8 — 5 1/8	4 5/8 — 5 1/8	..	..	..	5 7 4
70,000	Do. do. 4½ % 1st. deb. stock	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
29,798	Brompton & Kens. Elec. Lt. Sup., Ord., 1 to 20,000	5	10 %	10 %	10 %	10%	7 — 8	7 — 8	..	..	..	6 5 0
10,202	Do. do. 7 % Cum. Pref.	5	7 %	7 %	7 %	7 %	7 — 8	7 — 8	..	..	..	4 7 6
336,876	Central Electric Supply 4 % Guar. Deb. Stock	100	4 %	4 %	4 %	4 %	96 — 99	96 — 99	..	..	..	4 0 10
80,000	Charing Cross and Strand Electricity Supply	5	8 %	8 %	5 %	5 %	3 7/8 — 4 3/8	3 7/8 — 4 3/8	..	..	..	5 2 10
80,000	Do. do. 4½ % Cum. Pref.	5	4½%	4½%	4½%	4½%	3 3/4 — 4 1/4	3 3/4 — 4 1/4	..	..	..	5 5 11
80,000	Do. "City Undertaking" 4½ % Cum. Prf.	5	4½%	4½%	4½%	4½%	3 3/4 — 4 1/4	3 3/4 — 4 1/4	..	..	..	5 5 11
427,400	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	4 %	97 —100	95 — 98	..	..	—2	4 1 8
49,436	Chelsea Electricity Supply, Ord.	5	5½%	6 %	6 %	4½%	3 3/4 — 4 1/4	3 3/4 — 4 1/4	..	..	..	5 5 11
175,000£	Do. do. 4½ % Deb. Stock Red.	Stock	4½%	4½%	4½%	4½%	102 —105	102 —105	..	..	..	4 5 9
70,595	City of Londo Elec. Lighting, Ord. 40,001—110,595	10	5 %	6 %	6 %	6 %	9½ — 10¼	9½ — 10¼	10 1/8	..	..	5 14 3
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	6 %	11 — 12	11 — 12	11 1/8	..	..	5 0 0
400,000£	Do. 5 % Db. Stk., Scrip. (iss. at 115) all pd.	..	5 %	5 %	5 %	5 %	122 —125	122 —125	..	..	..	4 1 4
800,000	Do. 4½ % 2nd. Db. Stk., Prov. Crts., all pd.	100	4½%	4½%	4½%	4½%	95 — 98	95 — 98	..	..	..	4 11 10
40,000	County of Durham Electrical Power, Ord.	5	4 %	£3 7 0	4 %	4 %	3½ — 4¼	3½ — 4¼	..	..	..	4 14 1
50,000	Do. do. do. 5 % Pref.	5	5 %	5 %	5 %	5 %	4 3/8 — 4 7/8	4 3/8 — 4 7/8	..	..	..	5 2 7
40,000	County of London Electric Lighting, Ord. 1—40,000	10	4 %	4½%	5 %	5 %	6½ — 7½	6½ — 7½	7 1/8	..	..	6 13 4
40,000	Do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	6 %	10 — 10¾	10 — 10¾	10 7/16	..	..	5 11 8
400,000£	Do. do. 4½ % Deb. Stock	..	4½%	4½%	4½%	4½%	105 —108	105 —108	106½	..	..	4 12 9
400,000	Do. do. 4½ % 2nd. Deb. Stock	Stock	4½%	4½%	4½%	4½%	94 — 97	95 — 98	97	96	..	4 11 10
80,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	4 %	Nil	3/8 — 7/8	3/8 — 7/8	..	..	..	11 0 0
80,000	Do. do. 6 % Cum. Pref.	5	6 %	6 %	6 %	3 %	1 — 1½	1/2 — 1½	..	..	— ½	10 0 0
350,000	Do. do. 4½ % 1st Mort. Deb. Stk.	100	4½%	4½%	4½%	4½%	75 — 80	75 — 80	..	..	..	5 12 6
10,000	Folkestone, 1 to 10,000	5	5½%	5½%	5½%	5½%	4½ — 5	4½ — 5	..	..	..	5 10 0
10,000	Do. 5 % Cum. Pref., 1 to 10,000	5	..	..	5 %	5 %	4 7/8 — 5 3/8	4 7/8 — 5 3/8	..	..	..	4 13 0
90,000	Do. 4½ % 1st Deb. Stock	100	4½%	4½%	4½%	4½%	96 — 99	96 — 99	..	..	..	4 10 11
13,000	Hove, 1 to 13,000	5	8½%	8½%	9 %	9 %	6 3/8 — 6 7/8	6 3/8 — 6 7/8	..	..	..	6 10 11
21,000	Kensington and Knightsbridge Electric Ord.	5	12½	12 %	10 %	10 %	8 — 9	8 — 9	..	..	..	5 11 1
90,000	Do. do. do. 4 % Deben. Stk.	Stock	4 %	4 %	4 %	4 %	95 — 98	95 — 98	..	..	..	4 1 8
111,000	London Electric Supply Corporation, Limited, Ord.	3	Nil	3 %	4 %	4 %	1½ — 1¾	1½ — 1¾	..	..	..	6 16 2
70,000	Do. do. do. 6 % Pref.	5	6 %	6 %	6 %	6 %	4 — 4½	4 — 4½	..	..	..	6 13 4
374,395	Do. do. 4 % 1st Mort. Deb. Stk. Red.	Stock	4 %	4 %	4 %	4½%	89 — 93	87 — 91	..	..	—2	4 18 11
200,000	Metropolitan Electric Supply, 1 to 100,000	5	8½%	10 %	10 %	8 %	5 1/2 — 5 3/4	5 3/8 — 5 7/8	..	..	+ ¼	6 16 2
76,121	Do. 4½ % Cum. Pref. 1—71,106	5	4½%	4½%	4½%	4½%	4½ — 5	4½ — 5	..	..	..	4 10 0
220,000£	Do. 4½ % 1st Mort. Deben. Stock	..	4½%	4½%	4½%	4½%	102 —106	102 —106	..	..	..	4 4 11
250,000£	Do. 3½ % Mort. Deben. Stock Redem.	Stock	3½%	3½%	3½%	3½%	87 — 92	87 — 92	..	..	..	3 16 1
250,000	Midland Electric Corporation, 4½ % 1st Mort. Deb.	100	4½%	4½%	4½%	4½%	96½ — 99½	96½ — 99½	..	..	..	4 10 6
87,500	Newcastle-on-Tyne, 1 to 87,500	5	8 %	8 %	8 %	8 %	6½ — 6¾	6½ — 6¾	..	..	..	5 18 6
87,500	Do. 5 % Pref., 1 to 87,500	5	5 %	5 %	5 %	5 %	5 — 5¼	5 — 5¼	..	..	..	4 10 11
10,853	Notting Hill Electric Lighting	10	6 %	7 %	7½%	7½%	10½ — 11½	10½ — 11½	..	..	..	6 10 5
20,000	Oxford, 1 to 96 and 407 to 20,310	5	6½%	7 %	7 %	7 %	5 7/8 — 6	5 7/8 — 6	..	..	..	5 16 8
50,000	Do. 4 % Deb. Stock	100	4 %	4 %	4 %	4 %	95 — 97	95 — 97	..	..	..	4 2 6
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	12½%	10 %	7½ — 8½	7½ — 8½	..	..	..	6 1 3
20,000	Do. do. 7 % Pref. 20,081 to 40,080	5	7 %	7 %	7 %	7 %	6 — 7	6 1/2 — 7	6 17/32	..	+ ½	4 13 4
150,000£	Do. do. 3½ % Deb. Stock Red.	100	3½%	3½%	3 %	3½%	87 — 92	87 — 92	..	..	..	3 16 1
12,000	Smithfield Markets Electric Supply, Ord.	5	4 %	4 %	4 %	Nil	1/8 — 1/4	1/8 — 1/4	..	..	..	Nil
50,000	Do. do. do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	4 %	71 — 75	71 — 76	..	..	..	5 4 4
65,000	South London Electricity Supply, Ord.	5	3 %	4 %	4 %	3 %	2 3/8 — 2 7/8	2 1/2 — 3	..	..	+ ⅛	5 0 0
120,000	South Met. Elec. Lt. & Power, Ord.	1	Nil	Nil	2½%	2½%	3/8 — 1/2	3/8 — 1/2	..	..	..	3 6 8
117,968	Do. do. 7 % Pref.	1	7 %	7 %	7 %	7 %	1 1/16 — 1 1/8	1 1/16 — 1 1/8	..	..	..	5 17 11
200,000	Do. do. 4½ % 1st Deb. Stk.	100	4½%	4½%	4½%	4½%	99 —102	99 —102	..	..	..	4 8 3
80,000	Urban Electric Supply, Ord.	5	5 %	5 %	5 %	5 %	1 7/8 — 2 1/8	1 3/8 — 2 1/8	..	..	..	11 10 6
50,000	Do. do. 5 % Cum. Pref.	5	5 %	5 %	5 %	5 %	1 3/4 — 2 1/8	1 3/4 — 2 1/8	..	..	..	8 13 11
200,000	Do. do. 4½ % 1st Mort. Db. Stk. Red.	100	..	4½%	4½%	4½%	90 — 93	90 — 93	..	..	..	4 16 9
110,000	Westminster Electric Supply, Ord.	5	13½%	14 %	13 %	12 %	7 3/4 — 8 1/4	7 3/4 — 8 1/2	8 3/8	8 1/4	+ ¼	6 17 2
81,279	Do. do. 4½ % Cum. Pref. (Original 5 %—Red. to 4½ % from 31st Dec., 1905)	5	5 %	5 %	5 %	4½%	4 3/8 — 4 5/8	4 3/8 — 5 1/8	97/6	93/9	..	5 2 10

* Unless otherwise stated, all shares are fully paid. † Quotations on Liverpool Stock Exchange.

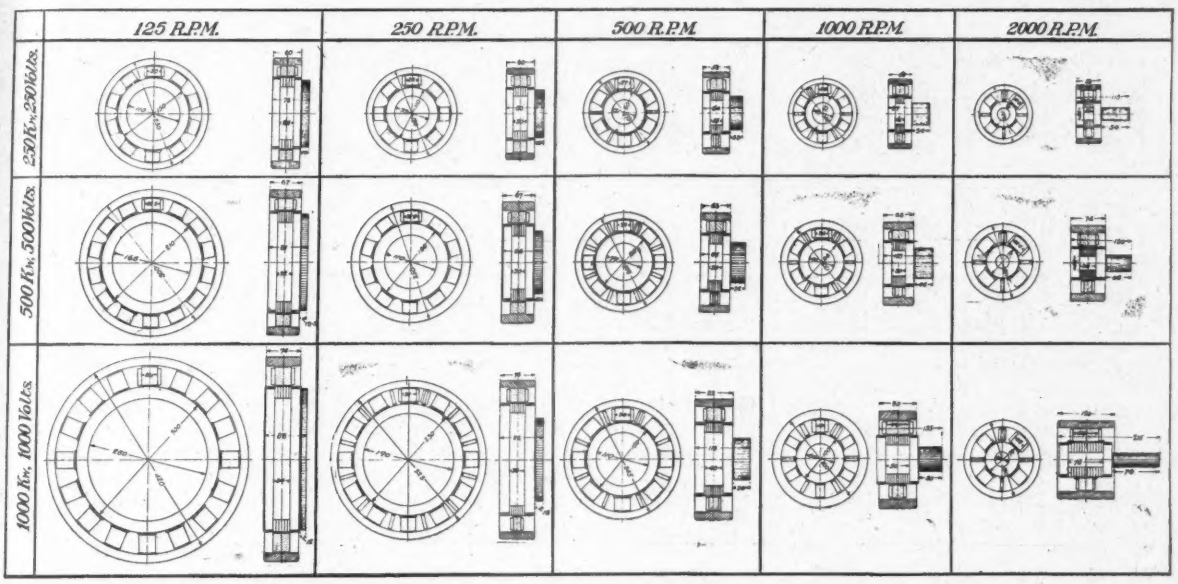
Bank rate of Discount 7 per cent., November 7th, 1907.

THE INFLUENCE OF THE RATED SPEED AND OUTPUT ON THE DESIGN OF CONTINUOUS-CURRENT GENERATORS.

By H. M. HOBART, M.Inst.C.E., and A. G. ELLIS, Assoc. A.I.E.E.

In a previous article (Electrical Review, September 6th, 13th and 20th, 1907), we have described a method of determining the leading dimensions of continuous-current generators of any rated output and speed, chiefly with reference to the reactance voltage as the commutation criterion. By means of this method, preliminary designs may readily be obtained, especially with a view to comparisons between designs and to a study of the influence of any factor, such as the rated speed or output. We there obtained the leading data for 500-kw., 250-volt continuous-current generators for speeds of 125, 250, 500, 1,000 and 2,000 r.p.m., and we instituted comparisons of the quality and cost of these designs, as a function of the speed. In the present article we have extended these considerations to designs for 250 and 1,000 kw. at speeds covering practically the same range as for the 500-kw. designs.

Before dealing with these outline designs, we have worked out in greater detail a number of designs for the same rated outputs at high and low speeds. These have been prepared



Figs 1, 2 & 3. Outline Sketches of 250 Kw 250 Volt, 500 Kw 500 Volt and 1000 Kw 1000 Volt Continuous Current Dynamos.

Figs. 1, 2 and 3.—Outline Sketches of 250, 500 and 1,000 kw. Designs contained in Table I, arranged in Order of Increasing Speed.

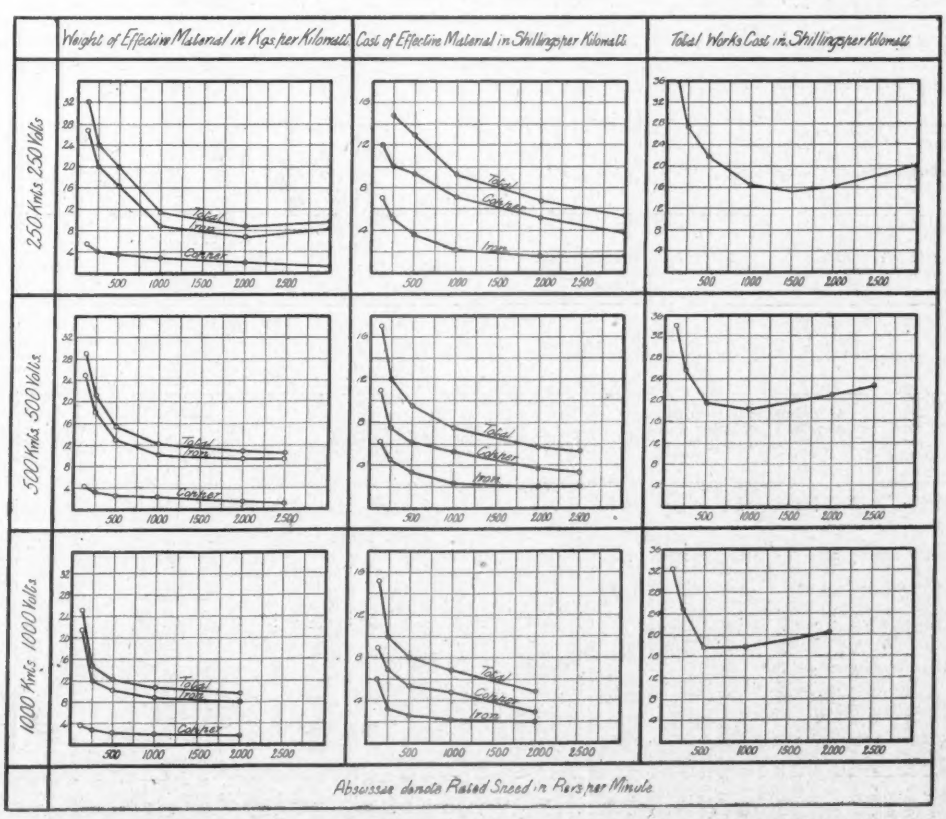

Weight of Effective Material in Kgs. per Kilowatt
Cost of Effective Material in Shillings per Kilowatt
Total Works Cost in Shillings per Kilowatt
250 Kws. 250 Volts
500 Kws. 500 Volts
1000 Kws. 1000 Volts
Total
Copper
Iron
Abscissae denote Rated Speed in Revs. per Minute

Fig. 4.—Curves showing Effective Weight, Cost of Effective Material, and Total Works Cost of 250, 500 and 1,000 kw. Continuous-current Dynamos at Different Rated Speeds.

TABLE I.

Rated output and terminal voltage.		250 kilowatts, 250 volts.					500 kilowatts, 500 volts.						1,000 kilowatts, 1,000 volts.					
Rated speed in R.P.M.	R	125	250	500	1,000	2,000	3,000	125	250	500	1,000	2,000	2,500	125	250	500	1,000	2,000
Number of poles	P	10	8	6	6	4	2	14	10	8	6	4	4	16	12	8	6	4
Frequency in cycles per second ...	N	10·5	16·7	25	50	66·6	50	14·7	21	33·3	50	66·6	83	16·7	25	33·3	50	66·6
Armature.																		
External diameter	D	150	110	90	75	55	40	210	160	120	96	70	57	300	233	150	100	70
Internal diameter of laminations ...	λ_y	110	73	51	43	26	12	165	110	77	55	40	29	240	190	110	60	30
Gross core length		28	30	25	21	23	31	32	30	30	30	33	50	34	32	40	60	75
Number of slots		140	100	84	100	100	70	240	150	144	100	88	64	400	330	200	162	100
Dimensions of slot		3·0×1·2	4·0×1·2	4·0×1·2	4·0×0·85	4·0×0·7	2·5×0·95	3·5×1·15	4·0×0·95	4·0×0·95	4·0×0·95	3·5×0·8	3·5×0·8	4·0×1·05	3·5×1·15	3·5×1·2	4·0×1·07	3·5×0·96
Armature peripheral speed ...	S_a	10	15	23	40	57	62	14	21	31	50	70	75	29	30	40	53	74
Commutator.																		
External diameter		140	100	70	58	34	22	230	130	82·5	58	34	27	290	170	86	58	34
Total axial length of segment ...		19	25	33	34	54	86	13·5	20	32	45	68	72	12	18	36	50	76
Number of segments		700	400	252	200	100	35	1,200	600	433	200	88	64	2,000	1,320	600	324	100
Commutator peripheral speed ...	S_c	9	13	18	30	35	35	13	17	22	30	35	35	19	22	30	35	35
Number of brush spindles		10	8	6	6	4	2	14	10	8	6	4	4	15	12	8	6	4
Frame.																		
External diameter		227	187	171	142	120	111	330	250	205	170	155	141	420	323	245	200	160
Internal diameter...		197	161	145	123	102	83	267	217	177	143	127	113	334	295	217	165	132
Width of yoke		60	60	58	49	53	65	67	67	63	63	74	81	74	74	82	80	120
Magnet core dia. (if of circ. cross-section)		30	28	27	21·5	21·5	30	32·5	32·5	30	30	32·5	50×19·5	36	32	34	49 × 18	56 × 28
Pole pitch		47	43	47	39	43	62	47	50	47	50	55	45	59	60	60	52·5	55
Radial depth of air-gap		0·5	0·5	0·5	0·5	0·4	0·4	0·8	0·7	0·6	0·6	0·5	0·5	1·0	0·8	0·7	0·7	0·6
Armature Winding.																		
Number of conductors per slot ...		10	8	6	4	2	1	10	8	6	4	2	2	10	8	6	4	2
Total number of conductors ...		1,400	800	500	400	200	70	2,400	1,200	860	400	176	128	4,000	2,640	1,200	648	200
Current density in amps. per sq. cm. ...		420	420	420	420	360	360	420	420	420	420	420	420	430	430	420	420	350
Magnetic Data.																		
Flux per pole at full load (megalines)...		8·8	7·8	6·2	3·9	3·9	7·4	10·5	10·5	7·2	7·7	8·8	9·5	12·8	9·6	10·5	9·5	15·3
Armature core density		12	12	12	12	12	12	12	12	12	12	12	9·5	12	12	12	8·3	10·4
Air-gap density (pole face)		9·5	8·7	8·8	8·0	6·6	5·3	10	10	8·3	8·5	7·3	9·8	9·8	8·3	7·3	7·2	6·2
Ampere-turns to overcome armature reaction		1,750	1,700	2,000	1,500	1,500	2,000	2,000	1,500	1,600	1,700	1,500	1,300	2,500	2,500	2,500	2,500	1,700
Total full load ampere-turns		7,660	8,340	9,020	7,960	6,910	7,200	11,470	9,300	8,200	9,010	7,900	8,330	15,300	11,900	11,800	10,700	8,350
No load ampere-turns (shunt)		5,200	5,900	6,400	6,000	5,000	4,800	8,380	6,950	6,130	6,730	6,160	6,850	12,000	8,900	8,800	7,700	6,300
Interpoles.																		
Cross-section of core		No interpoles.		55	50	55	55	No interpoles.		64	75	90	90	No interpoles		84	110	148
Turns per spool				13·5	11·0	11·0	15·0			13·0	10·5	11·5	10·0			18	18	13·0
Losses, Efficiency and Heating.																		
Total constant losses		8,400	8,710	8,540	9,790	9,700	9,260	19,430	17,550	17,780	19,980	19,870	19,690	38,900	31,500	31,800	28,460	34,840
Total variable losses		13,850	10,150	9,850	7,440	5,770	5,420	18,200	13,940	12,900	9,230	7,100	5,670	28,800	29,340	22,040	16,780	9,410
Total of all losses		22,250	18,860	18,390	17,230	15,470	14,680	37,630	31,490	30,680	29,210	26,970	25,360	67,700	60,840	53,840	45,240	44,250
Full-load efficiency		92%	92·8%	93·3%	93·7%	94·2%	94·6%	93·0%	94·0%	94·4%	95·0%	95·1%	95·1%	94·0%	94·5%	95%	95·5%	95·8%
Armature heating, watts per sq. dcm. ...		51	56	60	72	82	85	53	60	74	86	95	96	61	68	80	91	98
Commutator heating, watts per sq. dcm.		32	38	46	56	64	70	38	40	45	53	63	74	48	55	57	69	72
Technical Data and Constants.																		
Total weight of effective material in kg.		8,200	6,070	4,970	3,880	2,210	2,425	14,330	10,600	7,820	6,080	5,400	5,310	25,110	14,790	12,240	10,520	9,410
Total cost of effect. material in shillings		4,780	3,650	3,250	2,260	1,655	1,380	8,480	5,920	4,920	3,720	2,880	2,720	14,750	10,100	8,000	6,800	4,760
Reactance voltage		2·1	3·1	4·7	6·3	10·0	14·4	2·8	4·0	6·8	9·0	15·0	16·0	4·3	8·0	12·5	20·0	28·0
Volts per segment		3·6	5·0	6·0	7·5	10·0	14·3	5·8	8·3	9·3	15·0	23·0	31·0	8·9	9·0	13·3	18·5	40·0
Armature ampere-turns per pole ...		7,000	6,250	7,000	5,600	6,250	8,750	6,000	6,000	6,750	5,600	5,500	4,000	8,000	9,300	9,490	9,000	6,800
Armature amp.-tns. per cm. of periphery		150	145	148	140	145	144	110	120	140	112	100	90	135	155	155	170	115
Flux per sq. cm. of air-gap surface ...		6·7	6·1	5·3	4·8	4·0	3·8	7·0	5·2	5·2	5·1	4·5	4·3	6·4	5·0	4·4	3·6	3·7
$D^2 \times \lambda_y$ in decimetres		630	360	200	118	69	50	1,420	770	435	275	176	160	3,050	1,700	900	500	370
Output coefficient		3·2	2·8	2·5	2·1	1·8	1·65	2·8	2·6	2·3	1·8	1·4	1·25	2·6	2·4	2·2	2·0	1·33
Total works cost in shillings ...		9,200	6,880	5,400	4,160	4,080	4,800	17,000	12,880	9,720	9,480	10,800	11,200	32,400	25,200	18,000	17,600	20,400

partly as a check on the method of procedure previously described, and for the further purpose of determining to a more detailed extent the consequences of varying the rated speed for various rated outputs.

The designs have been prepared in three sets as follows :—

KW.		Volts.		R.P.M.
250	...	250	...	125, 250, 500, 1,000, 2,000, 3,000
500	...	500	...	125, 250, 500, 1,000, 2,000, 2,500
1,000	...	1,000	...	125, 250, 500, 1,000, 2,000

These designs have not been arrived at by employing the method outlined in the previous article and the chart given in fig. 7, of the previous article (see p. 442 of the ELECTRICAL REVIEW for Sept. 13th, 1907), but they have each been independently worked out with a fair degree of care by a process of repeated calculations. Even these designs are not, however, to be regarded as final, for it is a large undertaking even to prepare a set of designs merely in outline, for so many ratings, and while the present groups of designs afford good material for studying the consequences of various speeds and outputs, no individual design would be manufactured without subjecting it to further and much more exhaustive calculations and introducing all desirable modifications. These might often be very extensive.

Of course, the principles were kept in mind, but instead of consulting the chart in question, the present designs were evolved independently of the precise assumptions on which the chart is based. While this is a much more laborious plan of procedure, it is, nevertheless, desirable to approach the subject from various standpoints, and the one method constitutes a check on the other. The highest speed in each case corresponds to a suitable speed for direct connection to a steam turbine of the Parsons type. With continuous-current generators of large rated output and low voltage, considerable difficulty is experienced in the design of a suitable commutator, owing to its extreme length. In view of the limitations imposed by commutator design, the voltage for each set of designs has been taken proportional to the output in kilowatts. This grading of the voltage permits of less unsatisfactory results as regards commutator dimensions.

Space will not permit of the inclusion of other than very brief specifications of these designs, but we give in Table I the leading data, and from the complete specifications we have obtained the curves in figs. 4 and 5 showing the leading characteristics.

In addition to the data given in Table I, the following points may be observed :—

The current density at the brush contact surface is 8, 7 and 5 amperes per sq. cm. for the 250, 500 and 1,000-volt designs respectively.

The width of commutator segment plus insulation at the periphery, is in no case less than 0·4 cm.

The designs all have one turn per commutator segment.

The flux densities in the magnet cores and yoke are 15 and 6 kilolines per sq. cm. respectively. The armature and commutator heating coefficients are shown in the specification. The shunt spools are proportioned for a value of the watts per sq. dcm. of external surface, of from 9·5 to 11, the main series spools 11 and the interpole series spools 12.

Outline drawings of all these machines are brought together in figs. 1, 2 and 3, p. 1029, where the principal dimensions are shown. In figs. 4 and 5, the chief quantities

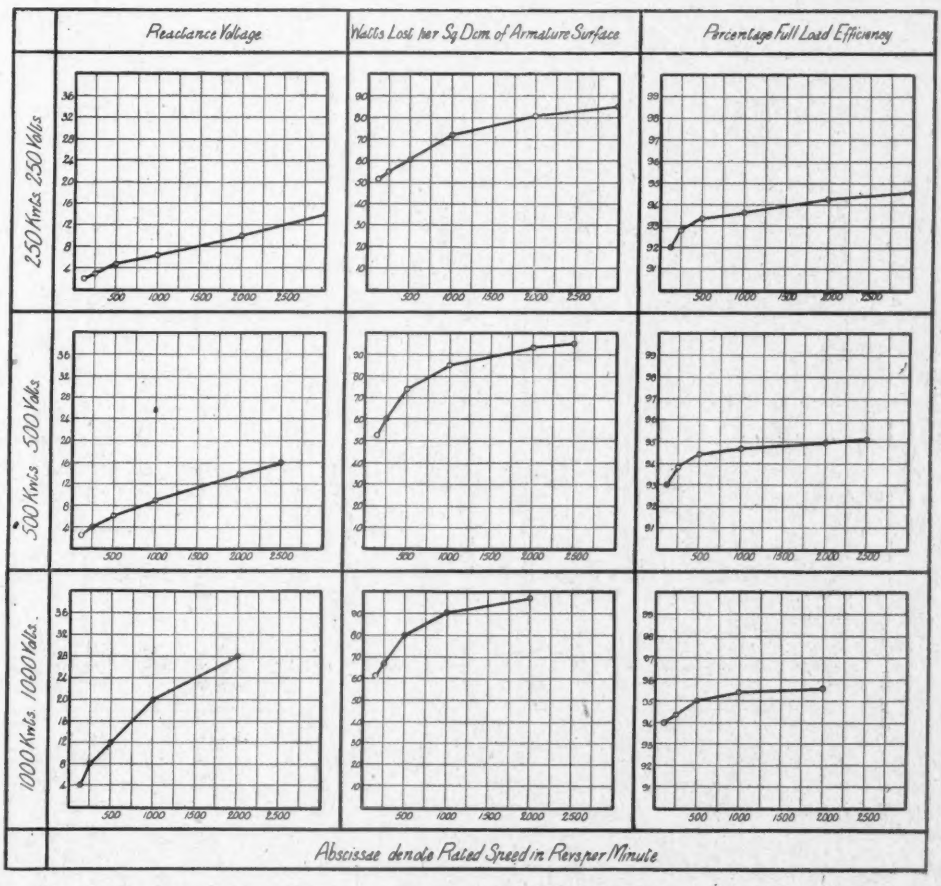

Reactance Voltage
Watts Lost per Sq Dcm of Armature Surface
Percentage Full Load Efficiency
250 Kws 250 Volts
500 Kws 500 Volts
1000 Kws 1000 Volts
Abscissae denote Rated Speed in Revs per Minute

FIG. 5.—CURVES SHOWING TECHNICAL DATA OF 250, 500 AND 1,000 KW. CONTINUOUS-CURRENT DYNAMOS AT DIFFERENT RATED SPEEDS.

of interest are plotted as a function of the speed. Fig. 4 relates to weights and costs.

There are plotted the weight and cost of effective material per KW. output; curves being shown for the copper and iron and total effective material. For a given rated speed, there is little difference between the weight and cost per KW. output for designs of different rated output. In the range of low speeds an increase in speed effects considerable decrease in weight and cost of effective material, but in the range of high speeds the weight and cost of effective material decreases but very slightly with increase in speed.

Fig. 4 also shows curves of the total works cost estimated on the basis of the formula

$$\text{TWC} = \text{K D} (\lambda_r + 0{\cdot}7\,\tau).$$

It will be observed that the total works cost for each rated output reaches a minimum value at a certain rated speed.

The speeds corresponding to minimum total works cost are approximately—

1,500 R.P.M. for 250 KW.
1,000 R.P.M. for 500 KW.
500 R.P.M. for 1,000 KW.

Fig. 5 shows the reactance voltage, the armature heating and the full load efficiency. The reactance voltage increases with the speed, rendering interpoles necessary on all designs other than those for the lowest speeds, as will be seen from the outline drawings.

Interpoles are employed in the designs for the following and all higher speeds :—

KW.	Speed for and above which interpoles are employed.	Reactance voltage at this speed.
250	500	4·7
500	500	6·8
1,000	250	8·0

In the following table are shown, for each rating, the speeds for and below which interpoles are not employed :—

KW.	Speed for and below which interpoles are not employed.	Reactance voltage at this speed.
250	250	3·1
500	250	4·0
1,000	125	4·3

The armature watts per square dcm. increase considerably with the speed, rendering liberal provision for ventilation necessary in the high-speed designs. The full-load efficiency improves with the speed on account of the smaller total losses, which are a consequence of the small dimensions for the high-speed machines. The data of the designs which we have described above, permit of determining roughly the most economical rated speed, with due regard to satisfactory operation and general reliability, for continuous-current dynamos of any reasonable output and voltage.

In such determinations due regard must be paid to arriving at a compromise between commutation, thermal considerations, cost and general reliability.

(*To be continued.*)

GREAT INTERNATIONAL EXHIBITIONS.

THE subject of International Exhibitions naturally falls under the time-honoured three heads :—The Participation of Great Britain in Past Exhibitions ; The General Effect of Exhibitions on British Arts, Industries, and Trades ; Recommendations. It was under these three heads that the Committee appointed by the Board of Trade divided the Report which they signed on August 17th last ; they were appointed by Mr. Lloyd-George on November 2nd, 1905 ; they held 30 meetings and examined 56 witnesses, and, as we said in a former issue,* it is to be hoped that the usual result of such committees will not follow, and that the subject will not be, in the fulness of official time, decently shelved. The Committee was composed of three Board of Trade officials, one each from the Treasury and the Foreign and Colonial Offices, one Member of Parliament and three private gentlemen.

The Committee's main inquiries referred to great International Exhibitions, although minor and special exhibitions were often referred to incidentally. That these have their uses cannot be denied, but they are rather outside the subject of such exhibitions to which the Government might fairly be asked to contribute in a substantial and adequate manner. Like most human "notions," the practice of exhibitions or national displays can be traced very far back. Ahasuerus held a six months' exhibition, in which "he showed the riches of his glorious kingdom." These shows have been traced by industrious students from those times, through the great fairs of Leipzig, of Nijni-Novgorod, and of Tantah in Egypt, down to the first Great International Exhibition started by the Prince Consort and most successfully carried through under his auspices in 1851. No fewer than 11 Expositions have been held in Paris between 1797 and 1900, the last being held in the Champs Elysées, at which the exhibitors numbered 4,494 ; besides these there were numberless provincial and special exhibitions in France. Similar undertakings were more or less successful in most Continental countries, and "International" Exhibitions were held in London in 1855, 1862 and 1867 ; since then there has been none in the metropolis, except those devoted to special industries, but many very important exhibitions have taken place since 1851 in most of the principal towns of the United Kingdom. Not all of these come within the scope of these remarks, which are confined to our participation in great International Exhibitions other than those held in this country.

There have been no fewer than 23 of these, at which the Government expenditure amounted to less than £640,000, or an average of no more than £27,800. No other country has participated in so many exhibitions. The United States on five spent £361,980, an average of £72,396 ; the corresponding figures for Italy are three, £120,100 and £40,033 ; for Germany five, £636,000 and £127,200 ; for Austria-Hungary 12, £225,059 and £18,755 (including London in 1902 and Earl's Court in 1906) ; France 10, £150,547 and £15,055, and even India participated in 17 exhibitions, for which the Government granted £304,111, or an average of £17,888. The totals were 52 exhibitions, nearly £1,800,000 in grants, or an average of £34,573 per country per exhibition, against our £27,800. Taking the last two exhibitions for which figures are available, it is found that at Chicago in 1893 the Government grants were :—Germany, £180,000 ; France, £80,104 ; United Kingdom, £61,164 ; Austria, £12,500 ; and Italy, £8,000. At Paris in 1900 the figures were :—United States, £291,145 ; Germany, £250,000 ; Austria, £125,000 ; United Kingdom, £97,033 ; Italy, £76,800.

The Government grants at the 23 exhibitions were as under :—1853, New York, under a Royal Commission, £2,432. 1855, Paris, under the Science and Art Department, £41,253 ; this was really a one-man Commission under Sir Henry Cole. The French Government lost mainly on this occasion. 1867, Paris, £120,556, was under a Royal Commission. It was on this occasion that the ingenious system was introduced whereby countries and classes were both kept distinct—the exhibition was so laid out that classes were divided longitudinally and countries transversely ; so that starting from the centre and walking radially the visitor passed from the Fine Arts in the centre, through the different classes, to the machinery on the outside—all belonging to one country. If, on the other hand, a circumferential walk was undertaken, the same class would be passed through though belonging to different countries. This arrangement, although most excellent in theory, has been found impossible in practice since exhibitions have grown so enormously in size. Collective exhibits were tried for the first time ; the Government Departments were well represented, but time was lost in settling the amount of the grant.

1873, Vienna, £30,352, under a Royal Commission. This was managed by Sir P. Cunliffe Owen, whose relations with both the authorities and the British exhibitors were most cordial. Although an outbreak of cholera diminished the number of visitors, the exhibitors were quite satisfied with the results, as putting them in touch with the people of countries to which such intimate access would otherwise have been difficult.

1875, Paris, £1,973.—This was a Maritime Exhibition only, and calls for no particular notice. 1876, Philadelphia, £40,462, under the Science and Art Department, Sir P. Cunliffe Owen having organised the British Section, which was placed in the care of Colonel Sir Herbert Sandford. The relations between the British Commission and the American officials were most cordial, and there were but few complaints from British exhibitors. The display by Great Britain upheld its reputation as a manufacturing nation, and was superior in that respect to Germany's and even to that of the United States themselves. Sir Herbert estimated that the average value of each exhibitor's goods was £400, and that his expenses amounted to £190. A system of single judges for the awards was tried, but practically broke down. One of the exhibits was an English villa of the "Bedford Park"

* "Milan : a Retrospect," January 11th, 1907, p. 77.

type, and it had a marked effect on American domestic architecture, though it is not known to have brought much grist to the mill of the British architect. British manufacturers were keen to get on the American markets at that time, as prohibitive tariffs had not then been imposed.

1878, Paris, £73,712.—Under a Royal Commission, Sir P. Cunliffe Owen was their Executive Commissioner, and here, again, the relations between all parties, French, British and Colonial, were excellent. We held the foremost position, for the United States were poorly represented, and Germany not at all. Russia, on the other hand, for political reasons, made a magnificent display. It was at this exhibition that side-shows first became prominent, as has been truly said, "combining a sort of respectable Vauxhall or Cremorne with an international exhibition." Here, also, the longitudinal and transverse system of grouping was again attempted. The carriage-makers, especially, made a brave show; in fact, in the opinion of many, the Empire made a better impression at this exhibition than at any other before or since. The only complaints arose after it was over, owing to the difficulty in finding the packing cases.

1879, Sydney; 1880, Melbourne, £9,203.—Under a Royal Commission represented by Colonel Sir Herbert Sandford; this amount was absolutely inadequate, so much so that, on his arrival, he had absolutely no funds whatever wherewith to administer his court, and the Colonies had to vote money for decorating it, and for the salary of his clerk. The grant was nearly all spent on the Art section, and on the commissioner's salary. The British exhibits were good, but bore no proportion whatever to the importance of the trade between Great Britain and Australia; on the other hand, France, Germany, Austria, and even Belgium and Italy managed to decorate their courts themselves in a thoroughly artistic manner.

1885, Antwerp, £198; New Orleans, £200; 1887, Barcelona, £85.—Under a Foreign Office agent. With regard to the first two of these, the above figures are the only references to them in the Committee's report, of which free use is being made. Of Barcelona it is reported that we were very poorly represented there, "the British court being confined chiefly to lavatory fittings," although the New Treaty of Commerce for the introduction of British manufactures into Spain had been signed; in fact, many Britishers felt ashamed of their country, and wished we had kept away if we could not do better. This occasion was noteworthy for the fact that the *Comité Français des Expositions à l'Etranger* originated in a special committee that was formed in 1885 for the participation of France in this Exhibition.

1887, Adelaide, £3,864; 1888, Melbourne, £6,557—both under Royal Commissions; 1891, Jamaica, £1,000, under a Colonial Office Committee. No further mention of these three occurs in the report.

1889, Paris.—This exhibition was looked upon as a Centenary celebration of the Revolution, and therefore many monarchical nations did not take part in it officially—ours amongst the number. But Lord Salisbury desired that we should participate in it, and invited the Lord Mayor of London, Sir Polydore de Keyser, to take action, as manufacturers were beginning to grumble at our abstention. Lord Brassey was associated with Sir Polydore, who was a most energetic man, and between them they performed what was considered a *tour de force*, which it would be almost impossible to repeat. The lack of Government support was, of course, very injurious, but not so much as was anticipated, for, naturally, less was expected and, indeed, there was no entertaining, except what was done privately. Opinions differed as to the result; some considered that we were well represented, that the committee was a very good one, and that the exhibits were very well done; others thought that their quality was poor, and that our show was not good as a whole; indeed, that it showed a falling-off for the first time since 1878. The machinery and engineering sections in general were, however, taken up warmly, and were as good as we had brought together up to that time. One maker of general mechanical and electrical machines and of machine tools spent no less than £4,000. The Society of Agricultural Engineers and the Institution of Carriage Builders tried to get up collective exhibits, but did not succeed. The awards were made by juries who were guided more by an exhibitor's reputation than anything else, considering that no committee could come and look at a man's exhibit and decide on its merits in that way. The British and Colonial Sections covered 218,000 sq. ft.; Belgium, 120,000; the United States, 113,000; and Switzerland, 65,000. The *Comité Français des Expositions à l'Etranger* worked for the first time on a large scale, and succeeded in showing a homogeneous exhibit of the various classes of French industry—but at some expense, for the cost of their collective exhibits and of our single displays did not vary a great deal. The side-show business was very much in evidence.

(*To be continued.*)

ELECTRICAL PUMPING INSTALLATIONS.

When laying down a modern electrically-operated mine unwatering plant, it is customary to employ high-lift centrifugal pumps in preference to those of the ram type—which were previously very generally used for this class of work—on account of the much higher speed at which they run. An electric motor to be coupled directly to a ram pump must be designed to run at a very low speed, and consequently will be of a large size in comparison to its output, and will occupy a great deal of valuable space. A very compact set, however, is obtained by the combination of a centrifugal pump with an electric motor, and the costs of erection, which mount rapidly with the size of a machine, when installed underground, are substantially reduced.

Photographs of two plants of this nature are reproduced in the accompanying figures. In each case the motor was made by the Felten & Guilleaume-Lahmeyerwerke A.-G., of Frankfort-on-Maine, the pumps being supplied by Messrs. Sulzer Bros., of Winterthur.

Fig. 1 illustrates an unwatering plant installed in the Wildberg Mine, Bohemia. It comprises two high-lift centrifugal pumps,

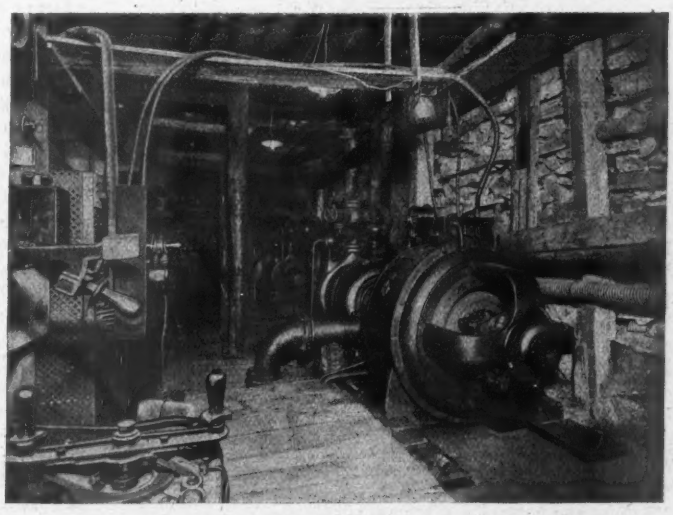


Fig. 1.

each capable of delivering 330 gallons of water per minute, against a manometric head of 755 ft., when running at 1,460 r.p.m., or the same quantity of water against a head of 1,036 ft., when the speed is increased to 1,715 r.p.m. The driving motors are direct-current shunt machines, each developing 175 h.p. The high speed necessitates a construction similar to that of turbo-dynamos, the armature diameter being only 18·9 in. (480 mm.), while the core length is 9·8 in. (250 mm.). The peripheral speed of the armature at 1,715 r.p.m., is, therefore, about 141 ft. (43 m.) per second. The diameter of the commutator, also, has been kept as small as possible, it being 9·8 in. (250 mm.). Its peripheral speed is, nevertheless, about 72 ft. (22 m.) per sec., and it is, therefore, held together by means of two shrunk rings. A fan is mounted on one side of the armature to cool the machine.

As may be seen in the figure, the motors are mounted on slides,

so that they may be moved in an axial direction to afford easy access to the pumps at any time for the purpose of cleaning them.

Fig. 2 illustrates a pumping plant installed in the Massener Tiefbau pit, Massen, Westphalia. The driving motor is a three-phase induction type machine, with slip-rings for starting, and develops 470 H.P. at 2,000 volts, and 1,455 R.P.M., enabling the pump to raise 1,210 gals. of water per min. against a head of 877 ft.

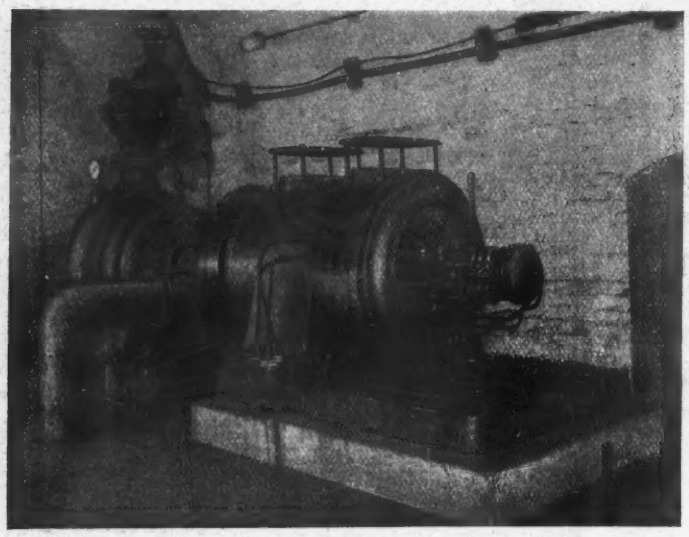


FIG. 2.

The rotor diameter of the motor is 23·4 in., and therefore the peripheral speed of the Massen machine is about 147 ft. per sec. The latter is constructed, as shown in the figure, with slip-rings mounted on an extension of the rotor shaft beyond the bearing to facilitate inspection. This machine also is mounted on slides, with a central worm screw, to which a ratcheted hand lever may be attached.

THE CHIEF IN EMBRYO.

BY R.

A CENTRAL station engineer at the present date, to be thoroughly successful, should have many qualifications.

The omniscience necessary for the ideal is, in fact, practically impossible to obtain, unless an individual has sufficient private means to carry him through workshops, college training and numerous junior positions in different branches. As this is the case, we are met with the problem of considering what training is likely to evolve a chief as near the ideal as possible.

The position of second engineer is evidently one of interest, for here the chief in embryo may be seen.

In some stations we meet the electrically specialised, in others the mechanically specialised second engineer. The remainder of the staff in either case is, of course, composed to balance up. Let us first take the case of the mechanically-trained second engineer. He will *principally* occupy the position of Station Superintendent, with a certain portion of his time spent in supervising the outside department—in reality the latter part will probably only come under his direct supervision during the absence of the Chief, and it is impossible to keep in close touch with the outside department unless one devotes a good deal of time to it.

If he be a keen man his time will be to a large extent occupied in the works, and what spare time there is may be spent outside in the interests of power load. He will not probably be able to keep in close touch with the bulk of the mains work, and must of necessity leave a good deal to an experienced assistant.

The station, from an electrical point of view, will not receive very much attention, excepting to keep the machines so that they will run. The switchboard attendants will be trained to give more attention to changing over from one set to another at the right time to obtain the best economy than to the study of correct paralleling and good voltage regulation.

The utmost station efficiency is very desirable, but the tendency may be to strain at a gnat and lose an eagle, or, in other words, the same percentage increase in output is more valuable than the decrease in running costs. An "outside" man realises nearly every day that steady voltage means the difference between a good and a bad advertisement to the supply company.

To turn now to the specialised electrical second engineer, one probably sees the station receiving comparatively slight attention, whilst the mains department will occupy most of his time. The station mechanical work will be mostly left in the hands of an assistant and the head fitter. The switchboard attendants will receive a considerable amount of attention.

The electrical second may, however, lose in one respect outside; he may have great experience in electrical matters, and yet not be able immediately to put his finger on the weak spot in a factory drive—and this has a considerable influence in obtaining power load.

To give an instance, there was an engineer, a very near approach to my ideal chief, who went to a large textile manufacturing company's works one day, and had a quick walk round the shops and about half an hour's conversation with the manager. The impression made was evidently very considerable—in the town next day one of the company's employés was heard to remark: "That electrical man knows a —— sight more about our place nor we does. 'E took a run through the works and told the boss exactly how and where, and how much power we be losing always. We tried last night, and he was right, too!" The immediate result was a matter of a 10-H.P. motor, but although that chief has left the town, his plan of reorganisation of the textile works is gradually being carried out, I'm told.

The electrical second will probably also be more keen on correcting the shape of his load curve, and having more outside experience will be better able to see exactly what steps must be taken to gain the desired "extended peak."

A comparison of the qualifications developed in different departments may tend to clear the way towards showing the best path of evolution for the would-be chief. For station work, mechanical specialisation, moderate electrical training, and a certain amount of organisation is necessary. The mains work requires specialisation in organising, electrical and commercial matters and a moderate mechanical training. The comparison shows that the mains department calls for the longest training, and the largest knowledge. Again, a smart efficient mechanical assistant makes up for a specialised mechanical training to a certain degree at a cost of, say, 40s. per week, a smart efficient electrical assistant, say, at 30s., is a substitute for specialised electrical training, but the specialised organising and commercial training substitutes will more than overbalance the remaining 10s. per week; and the electrical assistant is harder to find, because technical colleges seem to regard central station work as a come-down for their electrical students. The reasons for this are: first, the frequent supposed lack of prospects; and, secondly, that the starting salary is of necessity small.

Thus far the conclusion is that mains training is essential, and also a certain amount of station work. Now supposing we wish to help a youngster who hopes some day to become a chief, we must obviously suggest a training and advise to the best of our ability how it is obtainable. According to my ideas, perhaps erroneous, the following should be the procedure.

Undoubtedly a technical college course must be undertaken, if possible electrical and mechanical, with the greater attention paid to electrical matters; a course of workshops is considered by some a *sine qua non*, by others as unneces-

sary but useful. After this a junior post in a small station, not very long in existence for choice, where a little bit of everything can be gone through from floor cleaning to managing. Provided the youngster be enthusiastic, he will not mind hard work whatever it be. He will probably make up for the possible lack of workshop training by assisting the fitting staff whenever possible; he will probably do a great deal of switchboard work, and get an insight into mains routine and the methods of dealing with consumers, possibly traction work and general repairs.

We see letters in the electrical papers scoffing at the amount and type of work that a junior assistant is required to do. Surely such letters are, in the interests of those juniors, very unwise and harmful? When one is young *esprit de corps* is what one wants, and it is that which pulls one through. The letters alluded to have the effect of persuading juniors that they are very badly treated, and make them lose their enthusiasm.

(Oh, ye letter-writers, grumblers and scoffers, be merciful and leave us our enthusiasm, if not our ideals.)

Now, providing the station our budding chief goes to is not one of long standing, probably he will also be able to see the work of organisation gradually proceeding and learn what *not* to do. If after his probationary period he can work up to a mains assistant's position, hold it for a year or two and then get transferred to the station for a time, all the better. If he then considers that he has assimilated all the knowledge it is possible to get from the undertaking, it is time for him to look out for another place, preferably on a larger undertaking, as a mains assistant or superintendent, depending on his qualifications. In this new position an advanced course in organisation can be taken, and the necessary qualifications may be added to his list, up to the point of feeling sufficient confidence in himself to take a second engineer's position when opportunity offers. After this, of course the next step—depending on ambition—is either a second engineer's place in a large station, or a chief's job in a small station; of the two, I would recommend the former on account of obtaining more experience without the chance of rusticating.

It is essential in the latter stages for anyone possessed with a conscience to feel absolutely confident that he can successfully and thoroughly carry out the work attached to the position he wishes to apply for.

Of course, I am speaking of chiefs of only moderate-sized stations; for a large undertaking a specialist at the head and a staff of specialists is the up-to-date ideal.

This subject is not often gone into in the technical papers, and I feel that it is one of interest both to chiefs existent and to chiefs in embryo.

THE IDEAL.

By A. K.

In this age of common sense, few people have any ideals left. Life is strenuous; the business of money-getting takes all the time and all the energy at the disposal of the ordinary individual. We may pass lightly over the fact that the money-getting efforts of the ordinary individual are usually efforts and nothing more, and consider the possibility of making our daily life more worth living.

Work, when there is no ideal in more or less remote view, is apt to become an obsession; so much is this the case that we frequently find worthy individuals boasting that they have put in thirteen, fourteen and fifteen hours' work in the twenty-four, and that they have no time even to read the papers. I think it was Georges Barral who said that this is, perhaps, the most fruitful cause of the undoubted mediocrity of modern intellects.

Men who are under the influence of this obsession decline to take any interest in anything whatever outside of the one narrow groove in which they work. They are like the man with the muck-rake, in "Pilgrim's Progress"; they give up something which is really worth having, for the sake of the single subject in which their interest lies.

Not only does a life of this kind contain little that is beneficial either to the community or to the individual, but it is fairly obvious that no person can be at his best even in his own particular line, if his point of view is so narrowed as it must necessarily be in the circumstances.

It may be wondered what all this has to do with electrical engineering. It is true that so far all that has been said would apply with equal force to any profession. Ours, however, is a profession in which men of almost any age—I was about to write "young men," but the qualification is not necessary—are liable to be set down in a provincial town, where they neither know, nor are known by, anybody. In such a case it is, indeed, rather laudable than otherwise if the man gives his whole heart to his work—he might very easily do worse—but he may, also very easily, do it in a wrong way. The ideal has a function to perform, and this function is that of keeping a man at his best. Artists, whatever form their art manifest itself in, have their ideals. That there is an ideal in electrical engineering I imagine no one will deny. No doubt every individual of us all has his own point of view and his own manner of regarding it, and it is well that it should be so.

I think it is an ideal as high as that of any artist, in the sense in which the word "artist" is ordinarily used, to work for the purification of the atmosphere of our towns and cities by the use of electric light and electric power; to utilise the energy stored up by natural processes to the utmost; to reduce to a minimum the losses incurred in generating, in distributing, and in metering; it is even an ideal to make a profit, although many people would think profit-making merely materialistic.

There is nothing visionary in this way of regarding our work. No law exists to prevent anyone who looks at practical affairs through a tinted glass, from having as practical a mind as one who boasts of that possession. It is set forward as an incentive to electrical engineers to look at what they hope to achieve, and so to do everything as to conduce to the ideal result. It is helpful to think that our profession is an art as well as a science, and to think that one is acting on the sound old principle of the greatest good of the greatest number by becoming a sound and efficient man.

The man who makes two blades of grass grow where one grew before, is a benefactor to mankind. I do not think I am the first to vary that by saying that the man who makes one ounce of coal do as much as two ounces did before, or who makes a penny go twice as far as formerly, is not less a benefactor to the race. The variation is apt, because the very desirable end of benefiting humanity is best achieved by keeping in view the ideal, of whose existence many are—perhaps wilfully, perhaps not wilfully—ignorant. Increased efficiency will arise from increased interest in the broad subject, and it does not need to be proved, that one's life is made better worth living, as well as more useful, by the same means.

NEW PATENTS APPLIED FOR, 1907.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

26,551. "Full-way swing joint for electric light fittings, also for conduit or any other electrical wiring purposes." E. Phillips. December 2nd.

26,607. "Improvements in and connected with direct-current electrical machinery." Felten & Guilleaume-Lahmeyer-Werke Act.-Ges. (Date applied for under Patents Act, 1901, December 6th, 1906, being date of application in Germany.) December 6th. (Complete.)

26,642. "Improvements in methods of and devices for protecting electrical systems and apparatus." E. E. F. Creighton. (Date applied for under Patents Act, 1901, February 23rd, 1907, being date of application in United States.) December 2nd. (Complete.)

26,643. "Improvements in and relating to electric systems of railway signalling." H. Leitner. December 2nd.

26,661. "Portable electric egg-testing lamp." H. Langham. December 3rd.

26,673. "Improved system of telegraphing or telephoning to or from a railway vehicle." J. Hodge. December 3rd.

26,674. "Improvements in sparking plugs." J. D. Adams. December 3rd.

26,711. "Improved spanner for insulators." H. O. Klauser. (Bros. Gierse, Germany.) December 3rd. (Complete.)

26,721. "Improvements in coils for telephony and other electrical purposes." J. A. Romer. December 3rd.

26,730. "Improvements in and relating to the manufacture of composition suitable for electric insulating and other purposes." F. Walton. December 3rd.

26,742. "Improvements in and relating to sparking plugs." A. Dumaire and E. Moonen. (Date applied for under Patents Act, 1901, December 8th, 1906, being date of application in France.) December 3rd. (Complete.)

26,762. "Transforming machine for operating arc lamp and incandescent lamp circuits of low voltage." W. SCHAFFER. (Date applied for under Patents Act, 1901, December 3rd, 1906, being date of application in Germany.) December 3rd. (Complete.)

26,779. "Improvements in measuring and consuming devices for gas electricity and the like." CHAMBERLAIN & HOOKHAM, LTD., and S. H. HOLDEN. December 4th.

26,797. "Improvements in or relating to starting switch sets or arrangements for polyphase motors." SIEMENS BROS. DYNAMO WORKS, LTD., and R. A. R. BOLTON. December 4th. (Complete.)

26,801. "Combined electric and magnetic curative device." J. WILLIG. December 4th.

26,810. "Improvements in or relating to the concentration of ores containing wolfram." M. RUTHENBURG. December 4th. (Complete.)

26,829. "Process for the electrolytical refining of copper." J. AWALOW. December 4th.

26,894. "Improvements in apparatus for producing high-frequency electric discharges." H. J. HADDAN. (Synchronous Static Co., United States.) December 4th. (Complete.)

26,838. "Improvements in the manufacture of electric glow-lamp filaments from metals and metallic oxides having high fusing points." H. P. R. L. PORSCKE, known as R. Pörscke. December 4th.

26,839. "Improved process of manufacturing filaments for electric glow-lamps from metals and metallic oxides having high fusing points." H. P. R. L. PORSCKE, known as R. Pörscke. December 4th. (Complete.)

26,840. "Improvements in the manufacture of glow lamp filaments and in the method of cementing the same to leading-in wires." H. P. R. L. PORSCKE, known as R. Pörscke. December 4th. (Complete.)

26,841. "Improved process of manufacturing filaments of non-fusible metals." H. P. R. L. PORSCKE, known as R. Pörscke. December 4th. (Complete.)

26,844. "Improvements in or relating to electric sparking devices and the like." G. BARTELS and LAND-UND SEEKABELWERKE AKT. GES. December 4th (Complete.)

26,846. "Improvements in and relating to arc lamps." ALLGEMEINE ELEKTRICITATS GESELLSCHAFT. (Date applied for under Patents Act, 1901, December 5th, 1906, being date of application in Germany.) December 4th. (Complete.)

26,848. "Improvements in and relating to electric heating devices." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 4th.

26,888. "Improvements in electric clocks." F. HOPE-JONES. December 5th.

26,911. "Improvements in or connected with commutating dynamo-electric machines." V. A. FYNN. December 5th.

26,920. "Improvement in electrical locking apparatus for railway signals." SIEMENS BROS. & Co., LTD. (Siemens & Halske Akt. Ges. Germany). December 5th. (Complete.)

26,923. "Improvements in and relating to trolley heads for overhead tramway systems." W. F. B. BROWN." (Garnet Bowden Holmes and W. D. Allen, New Zealand). December 5th.

26,925. "Method of ensuring insulation of the current conducting parts of high tension magneto-electric sparking apparatus." G. A. UNTERBERG and F. HELMLE, trading as Unterberg & Helmle. December 5th. (Complete.)

26,927. "Improvements in or connected with timing devices for internal combustion engines." F. E. T. BRISCOE. December 5th.

26,934. "Improvements in electric accumulators or storage batteries." S. A. INGREY and R. D. BOWMAN. December 5th.

26,937. "Improvements in coin-operated apparatus for controlling the supply of electricity." E. EVANS. December 5th. (Complete.)

26,938. "Improvements in electrical signalling systems for railways." H. L. RIDER. December 5th. (Complete.)

26,940. "Improvements in alloys useful as electric resistance conductors." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 5th.

26,968. "Improvements in galvanic electric batteries." G. SCHAULI. December 6th.

26,973. "Improvements in spark plugs for explosive engines." J. C. ANDERSON. December 6th. (Complete.)

26,986. "New or improved apparatus for guiding the contact pulley on the conducting pole of electrically propelled tramway cars on to the overhead wire." T. BROWN. December 6th.

26,993. "Improvements in trolley wheels such as are used on electric trolley cars." W. P. THOMPSON. (E. N. Luburg, A. H. Smith and W. W. Varney, United States.) December 6th.

27,010. "Improvements in telegraphic code condensers." NOBELS EXPLOSIVES CO., LTD., and M. B. DICKIE. December 6th. (Complete.)

27,034. "Improvements in electric arc lamps." W. J. DAVY. December 6th.

27,038. "Improvements in motor-starting devices." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 6th.

27,076. "Improvements in or relating to electric incandescent lamps." I. H. HEGNER. December 7th.

27,084. "Improvements in or relating to electric installations for the interior of drawing-rooms and the like." I. H. HEGNER. December 7th.

27,090. "Improved bracket for supporting or locating electric cables, pipes and the like." E. A. GILL. December 7th. (Complete.)

27,092. "Improvements in electric traction." H. B. ELLIOT. (H. B. Greenwood, Argentine Republic.) December 7th. (Complete.)

27,095. "Improvements in electrical welding machines." M. B. RYAN. December 7th. (Complete.)

27,130. "Improvements in incandescent electric lamps." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 7th.

27,131. "Improvements in and connected with electric distribution systems." BRITISH THOMSON-HOUSTON CO., LTD. (General Electric Co., United States.) December 7th.

27,132. "Improvements in and relating to arc lamps." BRITISH THOMSON-HOUSTON CO., LTD. (Allgemeine Elektricitäts Ges., Germany.) December 7th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool; price, post free, 9d. (in stamps).

1906.

SIGNALLING ON RAILWAYS. B. Jacobs and E. A. Bowden and R. J. Insell. 18,074. August 11th.

SAFETY PORTABLE MANUAL ELECTRIC GENERATOR FOR LIGHTING MINERS' SAFETY LAMPS. J. C. Bowie and J. H. Phelps. 22,647. October 18th.

ELECTRIC CONTROLLERS OR SWITCHES. British Thomson-Houston Co. (General Electric Co., United States.) 25,202. November 8th.

ELECTRIC MOTOR CONTROL SYSTEMS. British Thomson-Houston Co. and H. N. Sporborg. 25,208. November 8th.

COMBINED TERMINAL AND SWITCH FOR ATTACHING TO SPARKING PLUGS OF INTERNAL COMBUSTION ENGINES. W. F. Kelly. 25,429. November 12th.

ELECTRIC BLOCK SIGNALS. G. P. Finnigan. 25,569. November 13th.

CURRENT COLLECTING DEVICES FOR ELECTRICALLY-PROPELLED VEHICLES. British Thomson-Houston Co. (General Electric Co., United States.) 25,803. November 15th.

ELECTROLYTIC PRODUCTION OF METALLIC SHEETS, TUBES, WIRE STRIP OR THE LIKE. S. O. Cowper-Coles. 26,211. November 19th.

ANODES FOR ELECTRO-DEPOSITION. S. O. Cowper-Coles. 26,212. November 19th.

MANUFACTURE OF MAGNETIC MATERIAL. R. A. Hadfield. 26,664. November 28rd.

MANUFACTURE OF MAGNETIC MATERIAL. R. A. Hadfield. 26,665. November 23rd.

ELECTRICAL APPARATUS FOR LIGHTING GAS. F. Nehmer. 29,123. December 21st.

RAILWAY SIGNALLING AND COMMUNICATING APPARATUS. A. Brook. 29,158. December 21st.

1907.

MANUFACTURE OF ELECTRODES FOR ELECTROLYTIC PURPOSES. G. W. Johnson. (Chemische Fabrik Griesheim Elektron.) 5,223. March 4th.

ELECTRIC ARC LAMPS. Mermod Freres. 7,177. March 25th. (Date applied for under International Convention, March 28th, 1906.)

DYNAMO-ELECTRIC MACHINES HAVING RING-WOUND ARMATURES. R. M. Tingley. 7,519. March 28th. (Date applied for under International Convention, April 4th, 1906.)

HIGH TENSION IGNITION APPARATUS SUITABLE FOR INTERNAL COMBUSTION ENGINES. Soc. des Garages Krieger et Brasier. 8,556. April 12th. (Date applied for under International Convention, April 27th, 1906.)

ELECTRIC SWITCHES OR CIRCUIT BREAKERS. F. T. Bumstead and H. C. Gover. 8,913. April 17th.

INCANDESCENT ELECTRIC LAMPS. P. C. Triquet and J. J. Barrollier. 9,489. April 23rd.

MEASUREMENT OF ELECTRICAL ENERGY. F. Conrad and W. M. Bradshaw. 12,552. May 30th. (Date applied for under International Convention, June 4th, 1906.)

ARC LAMPS FOR CHANGING THE LUMINOUS INTENSITY IN ANY GIVEN DIRECTION. M. Fortuny. 14,087. June 18th. (Date applied for under International Convention, June 19th, 1906.)

REGULATION OF ELECTRIC CIRCUITS AND MEANS THEREFOR. Siemens Schuckertwerke Ges. 14,620. June 25th. (Date applied for under International Convention, June 26th, 1906.)

BOXED ELECTRIC SWITCHES, FUSES AND THE LIKE. Veritys, Ltd., and A. E. Gott. 14,797. June 27th.

ARMATURE FOR MAGNETO-INDUCTION MACHINES. G. C. Dymond. (E. Eisemann and Co., Germany.) 15,594. July 6th.

METHODS OF MANUFACTURING CONDUCTIVE FILAMENTS FOR USE IN ELECTRIC LAMPS OR OTHER APPARATUS. W. D. Coolidge. 17,360. July 29th. (Date applied for under International Convention, August 1st, 1906.)

ELECTRO-MAGNETIC CLUTCHES. J. Watzke. 1,049. January 15th.

SOUND SIGNALLING ON STREET, ROAD OR LIKE ELECTRICALLY AND OTHER SELF-PROPELLED VEHICLES OR LOCOMOTIVES. J. Taylor. 3,334. February 11th.

TELEPHONE EXCHANGE APPARATUS. W. H. Wheatley. (C. D. Enochs, United States.) 3,426. February 11th.

ELECTRIC ARC LAMPS. British Thomson-Houston Co. (General Electric Co.) 4,931. February 28th.

PROCESS FOR THE MANUFACTURE OF LEATHER FOR PRODUCING ELECTRICALLY-INSULATING WEARING APPAREL, OR FOR INSULATING ELECTRIC CONDUITS. H. Egger. 6,592. March 19th.

LUG OR TAKE-OFF FOR SECONDARY BATTERY ELEMENTS. C. L. Mason. 6,710. March 20th.

GUARD FOR TROLLEY WHEELS OF ELECTRIC TRAMCARS AND THE LIKE. T. McMorran. 7,758. April 3rd.

OSCILLATORY CIRCUITS OF RADIO-TELEGRAPH SYSTEMS. Amalgamated Radio-Telegraph Co. (H. Rosenthal, Germany.) 9,051. April 18th.

MAGNETO-ELECTRIC IGNITION DEVICE FOR MULTIPLE-CYLINDER EXPLOSION ENGINES. A. Rilling. 11,402. May 15th.

MEANS FOR HOLDING ELECTRICAL CONDENSERS AND THE LIKE. Marconi's Wireless Telegraph Co. and R. D. Bangay. 12,968. June 4th.

INCANDESCENT ELECTRIC LAMPS. W. E. Barras and G. Weddell. 19,808. September 4th.

ELECTRO-MAGNETIC DEVICES. Allgemeine Elektricitäts Ges. 20,226. September 10th. (Date applied for under International Convention, September 12th, 1903.)

ELECTRICAL AUTOMATIC SIGNALLING SYSTEMS FOR RAILWAYS. J. Sayers. 244. January 4th.

LEADS FOR IMPROVING COMMUTATION IN DYNAMO-ELECTRIC MACHINES. British Thomson-Houston Co. (General Electric Co., United States.) 727. January 11th.

ELECTRICAL SWITCHES. D. K. Morris and G. A. Lister. 1,334. January 18th.

SPARKING DEVICES OF EXPLOSION ENGINES. L. A. Gianoli. 1,952. January 25th.

APPARATUS FOR AUTOMATICALLY OPENING AND CLOSING ELECTRIC CIRCUITS. A. G. Brookes. (T. M. Foote, W. F. Wolfe and A. V. Young, United States and Germany.) 4,583. February 25th.

WIRELESS TELEGRAPH OR SIGNALLING SYSTEMS. A. H. C. Dunwoody. 5,331. March 5th. (Date applied for under International Convention, March 23rd, 1906.)

APPARATUS FOR TREATING ELECTRIC CONDUCTORS, ESPECIALLY APPLICABLE IN THE MANUFACTURE OF FILAMENTS FOR INCANDESCENT ELECTRIC LAMPS. British Thomson-Houston Co. (General Electric Co., United States.) 5,576. March 7th.

ELECTRIC SPARKING DEVICES. J. A. Jeffery and B. A. Jeffery. 6,498. March 18th.

COIN-FREED ELECTRICITY METERS. J. M. Tourtel. 6,603. March 19th.

ELECTRIC BELLS. O. R. Fischer. 6,675. March 20th.

ELECTRIC HEATERS. J. T. Howell. 9,921. March 29th. (Date applied for under International Convention, May 7th, 1906.)

ELECTRICAL MEASURING INSTRUMENTS. E. F. Northrup. 11,262. May 14th. (Date applied for under International Convention, May 26th, 1906.)

TELEPHONE TRANSMITTERS AND RECEIVERS. H. Jankelowitz. 12,761. June 3rd.

ELECTRIC SIGNALLING APPARATUS. Allgemeine Elektricitäts Ges. 13,837. June 14th. (Date applied for under International Convention, June 16th, 1906.)

REGULATING STARTER FOR SINGLE-PHASE AND POLYPHASE INDUCTION MOTORS. J. Bruncken. 15,643. July 8th.

ELECTRIC SEARCHLIGHT. Geb. Siemens & Co. 23,351. October 22nd. (Date applied for under International Convention, November 6th, 1906.)

ELECTROLYTIC RECTIFIERS. O. de Faria. 1,456. January 19th.

SUPPORTS AND CONNECTIONS OF ELECTRIC CONDUCTORS AND CABLES. N. Astafieff. 3,189. February 8th.

AERIALS FOR WIRELESS TELEGRAPHY AND THE LIKE. W. Fairweather. (The Brown Hoisting Machinery Co., United States.) 4,685. February 26th.

ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES. R. D. Mershon. 5,565. March 17th.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES. P. G. Triquet. 6,735. March 20th.

MOTOR-CONTROLLING RHEOSTATS. British Thomson-Houston Co. (General Electric Co., United States.) 6,907. March 22nd.

METHOD FOR DETECTING AND MEASURING ALTERNATING CURRENTS. B. Gati. 7,234. March 26th.

ELECTRO-MECHANICAL CONTROL OF HYDRAULIC LIFTS AND LIKE APPARATUS. R. A. Smith. 8,474. April 11th.